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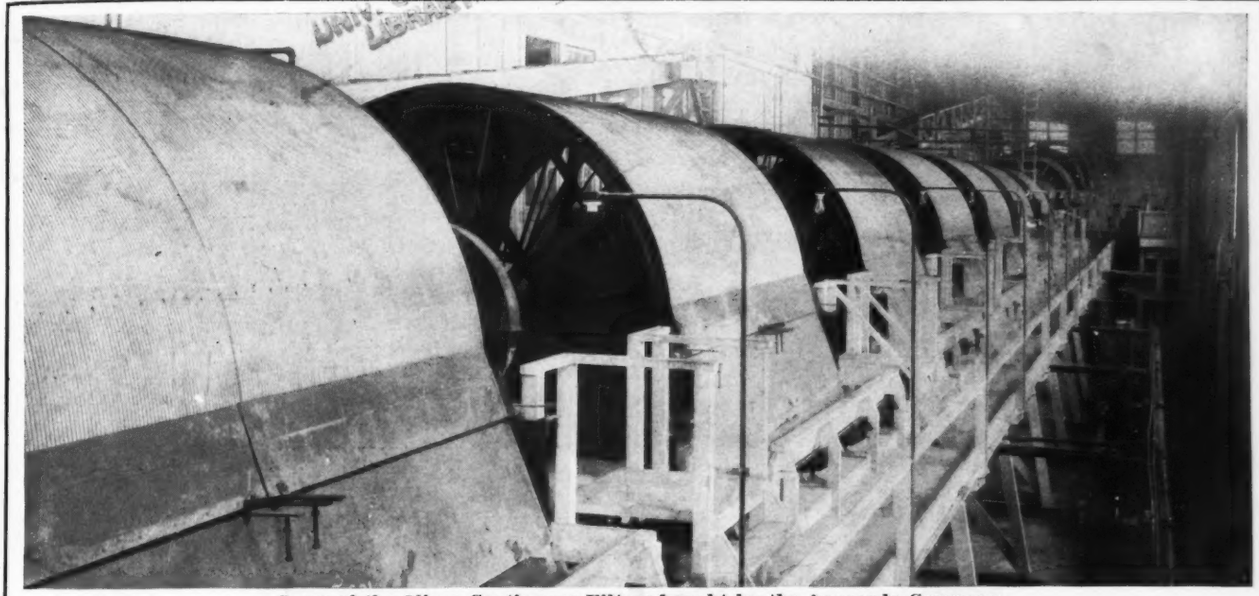

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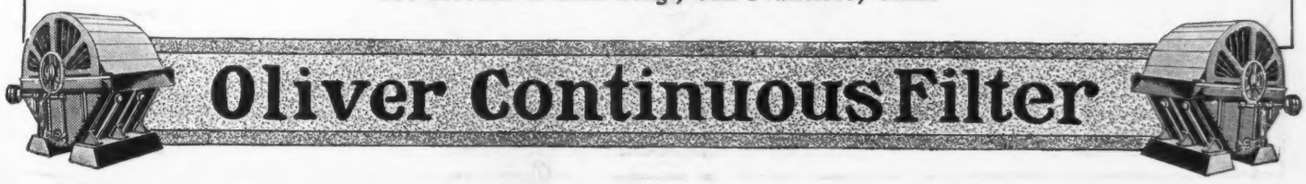

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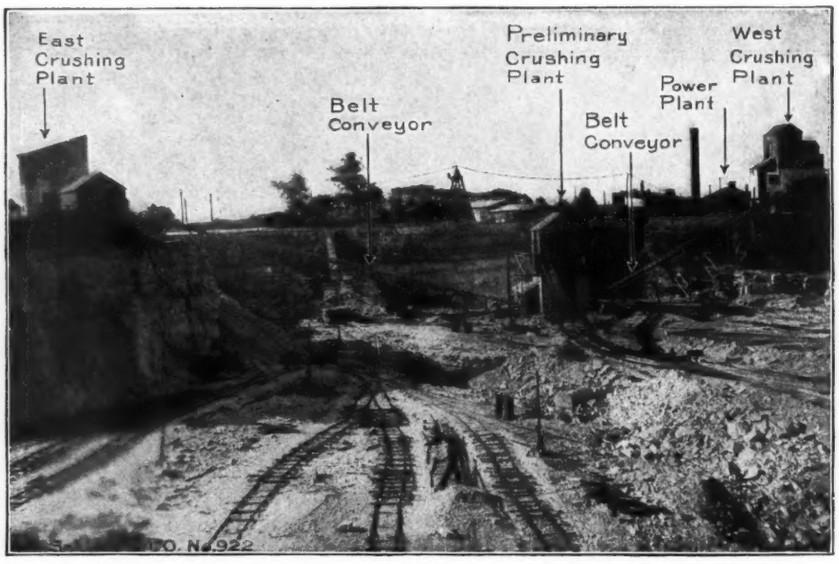

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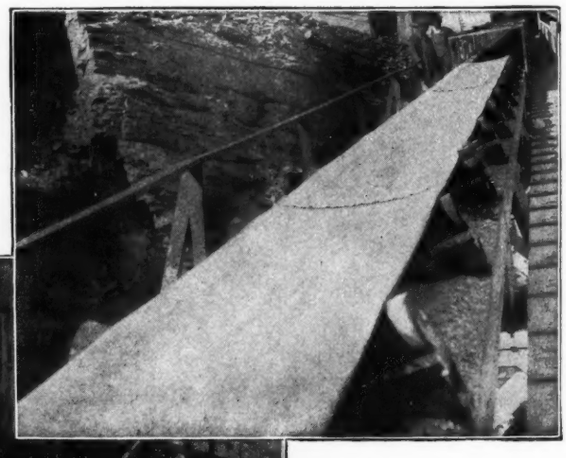

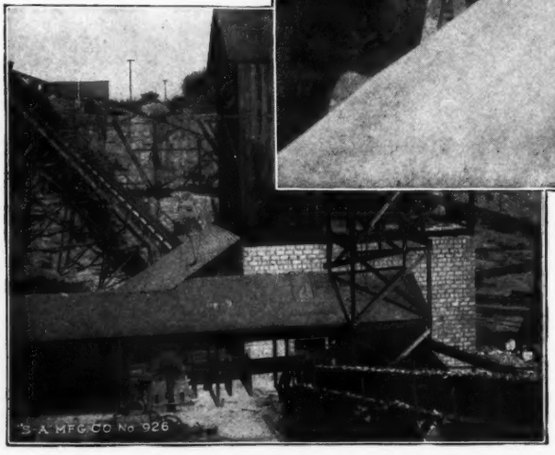

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Mining Journal

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Mitchell Top-Slice and Caving System

By Robert H. Dickson*

SYNOPSIS—Mitchell top-slice and caving system devised for use in heavy ground where grade of ore would not permit expense of square setting. Another distinguishing feature of the system is the use of slides which greatly reduce shoveling expense.

The orebodies at the Cole shaft of the Calumet & Arizona Mining Co., Bisbee, Ariz., consist of a series of roughly tabular lenses that are found in breaks cutting through the limestone. The material in these breaks consists of leached limestone, broken limestone and a limonitic clayey leached material, parts of which are impregnated with sufficient oxides and carbonates of copper to make ore. These lenses of ore in the leached material vary in size; some are several hundred feet long, 50 ft. wide and 50. ft. high. They vary in copper contents from 10% to as low as 4%. In order to mine some of these lenses that assayed 3 to 4% copper, it became necessary to devise a method that would be cheaper than square-setting, and yet be safe for the heavy ground. After much experimenting, M. W. Mitchell, mine foreman, developed the system known as the Mitchell top-slice and caving system, patterned after the top-slice and caving system as used in the Lake Superior mines and elsewhere, but so modified as to suit the local conditions.

After the extent of the orebody is determined by crosscuts and raises, it is cut into a series of sections by rows of square sets extending across the orebody at 45-ft. centers. Each row of sets is a single set in width and as long as the width of the orebody. Vertically this timbering extends, when completed, from the top of the ore to the bottom and is known as the gangway sets. The top of each section is then mined by the square-set method, one set high or more, so that there will be an even floor under which to start slicing. The ore below is then mined out in slices 8 to 10 ft. thick by running a series of contiguous drifts about 6 ft. wide across the section from one gangway to the other. As each slice is mined out, the back is caved and another slice is started below. While extracting the ore in these contiguous drifts, the roof is temporarily supported by props or bulkheads. The main haulageways are generally driven parallel to, and a short distance from, the lenses—usually paralleling the longer dimension. Crosscuts are driven at right angles to these across the orebodies at 45-ft. centers. Raises are then driven off these crosscuts, about 40 ft. apart up to the top of the orebody. These serve as manways and chutes to the

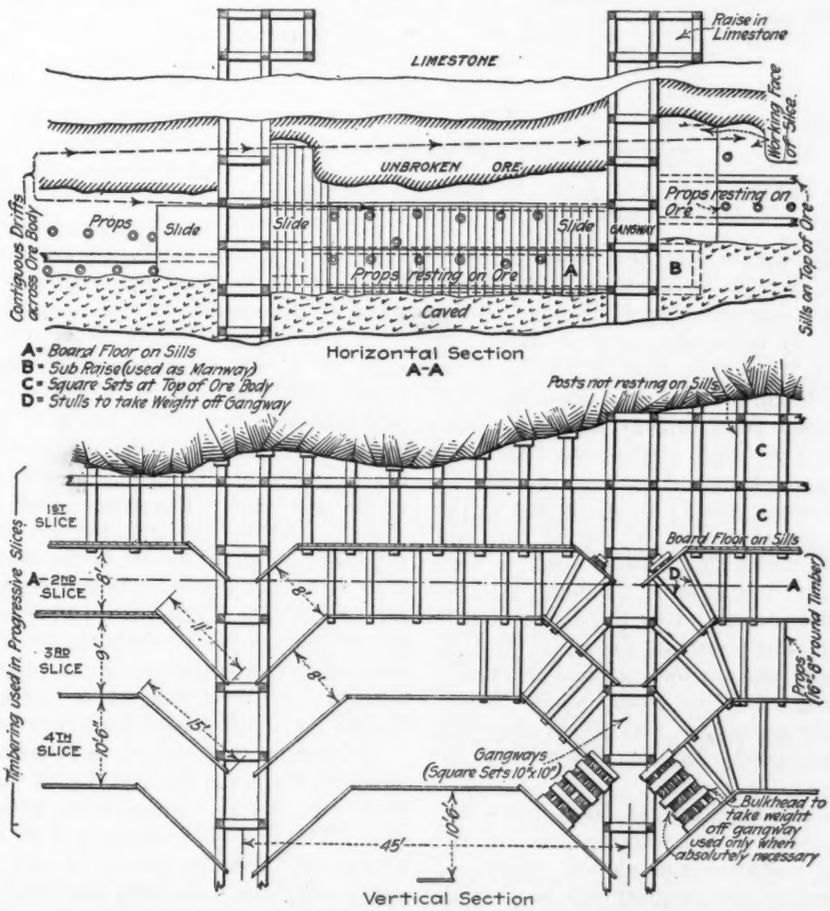


FIG. 1. MITCHELL TOP-SLICE SYSTEM AS APPLIED IN COLE MINE.

*Mining engineer, P. O. Box 1455, Bisbee, Ariz.

top of the stope and as a starter for the gangway sets. A row of lead sets, or gangway sets, is run from one raise to another at the top of the orebody so that it will be vertically over the crosscut on the level. In the meantime the top of the orebody is being mined by the square-set method until there is an even floor under which to start slicing. Usually one floor of square sets is sufficient. In slicing, each 45-ft. section is considered one unit. No sills are placed under the posts of the square sets; they are placed directly on the ground. After the ore has been taken out of the square sets, long sills of 4x10-in. timber are laid across the stope from one gangway to the other between each row of posts. A 2-in. plank floor is laid on these sills and serves to keep the fine waste (capping) from mixing with the ore during slicing. Then, if possible, the sets are filled with waste on top of this floor. This is to serve as a cushion for any ground to fall on in case the back does not immediately follow the caved timber after slicing has started below.

While the top of the orebody is being mined by the square-set system, a second row of gangway sets is run just below the first row, and then another row is started below this. After the square sets have been properly filled, or the timbers shot down in case there is no filling, a drift is started from one gangway to another at the edge of the orebody just below the caved or square-set ground. The first 11 ft. of this drift is driven as an inclined raise on a 45° pitch, (see Fig. 1), then driven horizontally until it reaches a point halfway across the 45-ft. section. A similar drift is driven at the same time from the opposite gangway, and these two hole together in the center of the section. This 11 ft. of incline at the start of the drift serves as a slide for ore to run into the gangway sets. A contiguous parallel drift is then run across the orebody in the same manner. All the ore in the slice is finally taken out by this series of parallel contiguous drifts, each starting on a 45° incline, or slide. The sills above and any loose ground are caught up by props consisting of 8- or 10-in. round timber. These props rest on the ground, so that should they take weight, they will not crush, but be driven into the ground.

The gangway sets are kept several floors below the slicing floor. They serve as the working ways of the stope, affording both manways and chutes. Slides of 2-in. timber are placed in the gangway sets so that all the ore of the slice from any part of the slides, will run into a chute without any mucking. Usually the gangway sets are connected with a permanent raise, on waste, which is used as a manway and timbering into the slice.

As the ore is mined out in slices by contiguous drifts, 4x10-in. sills are laid across the section, about 5 ft. center to center between the props, in the same manner as with the sills at the top of the stope. A 2-in. board floor is likewise laid on these. The ground is allowed to cave to within 15 to 20 ft. of the working face as it moves across the slice from one side to the other. Just enough props are used to keep the back safe for this distance from the face. When the whole slice has been taken out across one section, the props are shot down, in case they have not already come down, and the capping is allowed to cave. Often it is hard to make the capping fall on starting a slice, but once it has started to cave, the ground often caves, following the working face at 15 to 20 ft., as fast as the slice can be worked.

After the ground above has settled, a slice is taken out below in the same manner as before, except that the slice slide in this case is 15 ft. long and the slice is 9 ft. high. With this longer slide more of the ore will fall into the chutes without mucking. On the completion of each slice the back is caved and a new one is started until the bottom of the ore is reached. In case the bottom of the ore extends below one haulage level, raises are run up from the level below and slicing is continued off the gangway sets as before. The distinguishing features of this system are the slides and gangways. The slides (slice slides) extend the whole length of the section and eliminate the largest part of the mucking. It is rarely necessary for a machine to be set up in a slide, as it can be set up in the gangway or in the horizontal part of the extraction drift. The ore runs off these slice slides on to a grizzly in the gangway and thence onto chute slides and into the chutes, from which it is loaded into cars. As the gangway sets are the working ways of the stopes, it is necessary to protect them from moving and crushing as the sections on both sides of it are being caved. Stulls placed on the stope slides are used to take the weight of the gangway timbers. In case the weight of the capping tends to disturb the gangway sets, the posts of the upper sets are chopped, or dislodged, in order to take the weight off the sets below. The gangway sets are kept intact during the crushing, because the top set, in position, does not bear any of the weight of the capping, and is usually 6 to 10 ft. below the horizontal floor, on which most of the weight falls. Bulkheads (see Fig. 2) in case of very heavy ground have proved to be very satisfactory in preserving the gangways, in the place of stulls. Two of them set up over a gangway act as an arch, which takes the weight of the gangway timbers onto the solid ground.

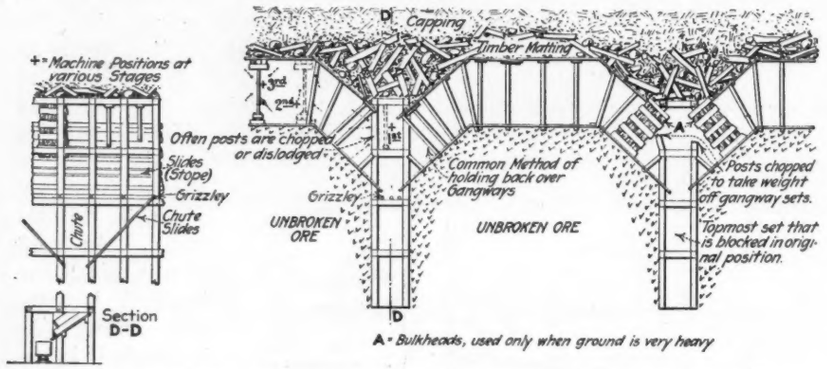


FIG. 2. SECTION SHOWING TIMBER MAT AND BULKHEADS FOR HEAVY GROUND

In starting this system, as is true in starting all new systems of mining, the men had to become familiar with their work before the maximum efficiency could be realized. The first slice was only 8 ft. high, the same as a square set. Finding this to be safe, the men next took out a 9-ft. slice. By this time they understood enough about the ground and how to use the props to the best advantage, so that they then took out a 10½-ft. slice,

which is the regulation height. The higher the slice the longer the slide and the less the mucking. At the start a great many more props were used than were actually needed, but with experience the men found out they could get along with fewer.

All drilling was done with 2¼-in. piston machines on a vertical column. The weight of the capping tended to crush the ore, so that a few long holes would break a large round. Several sections touching each other were worked at the same time. In working each 45-ft. section, it was divided into two equal parts, one-half being worked from the gangway on one side and the other from the gangway on the opposite side. The day shift worked the north half and the night shift the south half. In this way each crew was made directly responsible for its part of the stope. The production from a single section can be varied at will. If necessary, several contiguous drifts can be driven in the slice at the same time, one advancing ahead of the other. Usually a round can easily be put in in half a shift.

In this particular character of soft, heavy ground with rather small lenticular-shaped orebodies, this system of slicing and caving proved to be not only satisfactory, but also cheaper than square-setting. It permits a saving in labor, timber, powder and air. The slides minimize the amount of shoveling in the stope. Cheaper timber is used and, wherever possible, timber is taken out and used again. There is a small saving in powder and air, due to the crushing action of the capping. There will undoubtedly be a larger saving in timber and labor as the men become more familiar with the system, now new. So far this method has proved to be as safe as, if not safer than, ordinary square-set mining. Practically no ore is lost and any waste encountered can be thrown on the part of the floor about to be caved.

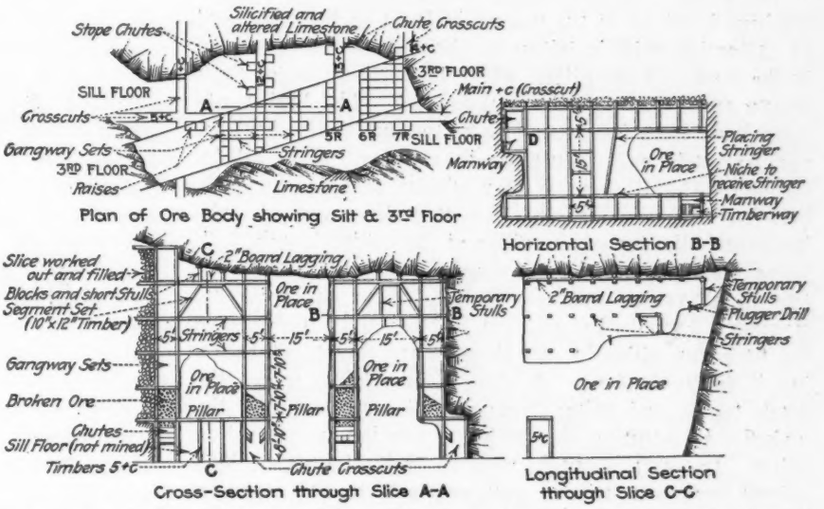


FIG. 3. MITCHELL TOP-SLICE SYSTEM AS APPLIED IN BRIGGS MINE

The orebodies of the Briggs mine consist of a series of lenticular masses of iron and copper sulphides, averaging from 3 to 15% copper. One of these orebodies is 400 ft. long, 70 ft. wide and extends 50 ft. above and 40 ft. below the main level. One side and the bottom of the orebody are limestone, while the other side is leached material and pyrite with a capping of siliceous breccia. The physical character of the ore in the lenses will not permit open stopes, but parts of them are favorable for the Mitchell top-slice system. The ore is of a fairly uniform grade, containing no horses of waste, and the back of the stope will stand for a short time with the timbers used.

Usually, before beginning mining operations, the orebody has been cut by several crosscuts at right angles to each other and several raises to the top of the orebody. The Mitchell top-slice then is used in four distinct steps:

1. The orebody is blocked out by chute crosscuts, driven at right angles to a main crosscut and spaced at an average interval of 40 ft. Raises are driven off the main crosscut at 20-ft. intervals to the top of the ore.

2. The orebody is cut into a series of pillars 15 ft. thick, by running single rows of lead, or gangway, sets from the first floor of the raises to the edge of the orebody. These are carried upward to the top of the orebody.

3. These pillars are mined by overhand stoping, and long stringers are placed between the two adjacent rows of gangway sets to keep up the back and hold the square sets in position.

4. The space occupied by the pillar is filled with waste, and the adjoining section is then mined out in the same manner.

Figure 3 is a section taken through one of the lenses, showing the sill and third floor. The ore was first cut by the prospecting crosscuts $1 + C$ and $5 + C$. One prospect raise was then put up at the intersection of $1 + C$ and $5 + C$ and another 60 ft. beyond it, off $5 + C$, to determine the height of the orebody.

As the first stage, the chute crosscuts are driven at right angles to $5 +$ at an average of 40 ft. center to center, starting at $1 + C$. These are driven to the edge of the orebody and later serve as haulageways from the stopes. Two-compartment timbered raises are put up, off $5 + C$ at 20-ft. intervals, starting at No. 1 raise, to the top of the orebody. Usually every second raise is carried up to the level above, to permit timbers being lowered into the stope, and also so that waste can be introduced as filling after the pillars have been mined out. In the case of the orebody in Fig. 3 the ore lying to the east of $5 +$ is only about 25 ft. wide, hence no crosscuts were driven off $5 +$ on this side. In most cases the crosscuts in ore require timbering.

This method contemplates mining only the ore from the first floor (8 ft. above the sill) to the top of the orebody at this period; the ore below will be mined at a later time. After the ore has been blocked out by raises and crosscuts, a single row of lead gangway sets is run at right angles to $5 +$ off the first floor of the chute compartment of each raise to the edge of the orebody. Every other row of gangway sets will be directly over, or at the side of, the top of the chute crosscuts. These sets, if over the crosscut, are taken out in the same manner as in square-set stoping—usually being drilled with a stoper machine. The row of lead sets not touching the chute crosscut are taken out by driving a crosscut with a machine on a vertical column and timbering it with regular square-set timbers laid on sills. Sets are carried

upward from these single rows of lead sets to the waste, as in regular square-set stoping. In this manner the orebody is cut into a series of pillars 15 ft. thick extending at right angles to the main crosscut across the whole width of the orebody. As the first row of lead sets, touching the chute crosscuts, is being taken out, a series of chutes is placed at the side of the crosscut by shooting out a small amount of ground. The ore mined above falls into these without mucking. In the odd line of gangway sets, which do not touch the chute crosscut, chutes are placed in front on the main crosscut. The ore is allowed to accumulate in these rows of sets until the material forms a slide, above which it will roll by gravity into the chute. The length of these rows of gangway sets does not usually exceed 40 ft. from the main crosscut. In the case of friable ores the sides of the sets are sometimes lagged.

Removing the Pillars

The next step consists in mining the pillars by first catching up the back with long stringers and then removing the ore in horizontal sections, beginning at the top of the pillar. In starting to mine the pillar, a piston machine is set up in the top set in front of the raise, and an extraction drift is driven on about a 30° pitch upward to the center of the pillar, where it meets a similar drift driven from the opposite gangway set. The broken ore runs down from the face of these inclined drifts into the gangway sets and thence to the chutes. A 10x10-in. stringer 14½ ft. long is then placed next to the back, between the posts of the two opposite gangway sets. Sometimes the top of the pillar at the center is only 2 ft. below the stringer. A drift contiguous to the first one is run in the same manner, making room for a second stringer. Usually the stringer is blocked temporarily to the back and pillar in case there is any danger of breaking it while shooting. A slice is thus taken across the whole top of each pillar, from the raise to the end of the orebody, by running this series of contiguous extraction drifts. The back is caught up with 15-ft. stringers, which extend from one row of gangway sets to the opposite. Two-inch lagging is placed across the stringers. No mucking is necessary, as the ore runs by gravity into the gangway sets and thence into the chutes.

While the last of the upper stringers are being placed in position, a second slice is started on the floor below, by taking a 5-ft. vertical cut (using a plugger machine) across the front of the pillar, sloping upward to the center of the pillar, as described. A 15-ft. stringer is then placed, butting up against the posts of two opposite gangway sets, as before, making two stringers in place, one 8 ft. above the other. A segment set consisting of two angles and a spreader is then placed between the upper and lower stringers, and the upper stringer is blocked to the back. As the second slice is being carried across the pillar, stringers and segment sets are placed between the gangway sets as before. Segment sets are used only at the top of the stope and are for the purpose of keeping up the back while the ore is being taken out of the pillar below. As the second slice is progressing from the front to the back of the stope, a third one is started below, in the same manner as before. The slices are progressively started at the front, so the ore will run toward the front part of the stope (over $5+C$), as the only chute in one gangway is in front. All the ore runs into the chutes without mucking until near the bottom; the ore in one corner of the stope must be shoveled, as it will no longer run into the chutes. The slices usually average 5 ft. in thickness, and the slope on the side nearest the chute crosscut is longer than the opposite side. Plugger machines are used exclusively except in starting the slice.

Often the top of the orebody extends above the top stringers a little distance. In this case the ore is usually mined out after the segment sets are in place, and short stulls are used to catch up the back. If the ore is only 2 to 3 ft. above the stringer, it is usually taken out before the stringer is placed in position.

Each stope has several outlets. The manways of the raises serve as ladderways and also for the purpose of bringing timber into the stope. Usually there is a manway at the end of the gangway sets from the chute crosscut. A timberway is partitioned off one corner of the manway with 1-in. boards and is used to bring tools and timber into the stope. The ladders are staggered and inclined, having a platform every 8 ft. The long stringers are usually

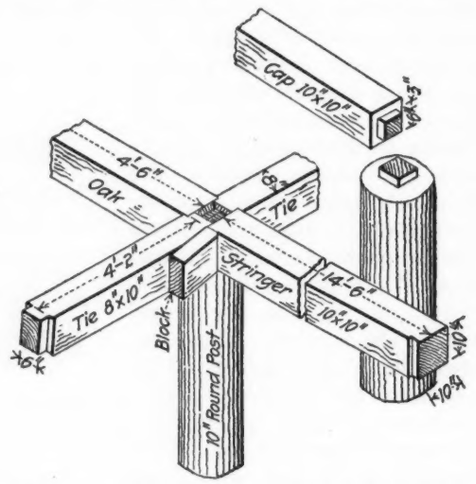


FIG. 4. DETAILS OF TIMBER FRAMING

lowered or hoisted (if necessary) through the manway in front, which has vertical ladders. When bringing a stringer into the stope from below, it is sometimes necessary to remove the cap in front of the raise, in order to get the stringer into the manway. Usually the stringer can be landed into the stope with little trouble.

Fig. 4 shows the details of the timbers. The cap tie and post are regular square-set timbers. The stringer is 14 ft. 6 in. long and squared off at both ends to fit into the gangway set. The stringers are placed in position by placing one end against the gangway sets as an ordinary cap is placed; and then the other end is swung to butt up against the set in the opposite gangway. To allow this being done, a niche (Fig. 4) has been previously chopped in the tie, making the stringer fit snugly against the horn of the posts. After the stringer is in place, a 2-in. block is nailed to the tie on this niche to hold the stringer in position.

In mining the orebody in Fig. 1, chute crosscuts were driven only on the west side of $5+$, as the ore on the east side extended only 20 ft. from $5+$. Gangway sets were driven on the same side, from the raises, and the pillars were mined as before. All of the broken ore rolled to the chute in the front of the stope.

After the ore has been mined out of the pillar, lagging is placed over the ore on the first floor, and the space occupied by the pillar is lagged off and filled with waste from the level above. A subraise is often run from the center of the back of the stope on an incline to one of the raises that extends to the level above, so that the waste will run directly to the center of the stope. The gangway sets are preserved, as they are used in mining the pillars on the opposite side to the one just mined. After one pillar has been mined, and the space occupied by it filled with waste, the adjoining pillar is mined.

The whole orebody is not all blocked out by raises, crosscuts and gangway sets before slicing is resorted to, but all these operations are going on progressively in different parts of the orebody at the same time.

Modifications of This Mining Method

The Mitchell top-slice system is worked in some places with slight modifications. The chute crosscuts are driven at 20-ft. centers and directly under where the gangway sets are to be, instead of at 40-ft. intervals. This obviates some mucking, as there is a row of chutes in each gangway set. Nearly all the crosscuts in ore at this mine have to be timbered, so it was considered cheaper to have the chute crosscuts twice as far apart and do a little more mucking than to drive the extra timbered crosscut. As this system was worked in the Oliver and Irish Mag mines, some of the timbers were taken out and re-used, but the character of ground would not permit it here. This system has been used on blocks of ore 100 ft. high. The block is divided into a lower and an upper 50 ft. The lower half is mined as I have described and then filled with waste. The upper half is then mined out, starting at the back and working down to the gob.

In order to use this system the orebody should be of large enough size; not too heavy and preferably free from horses of waste. It cannot be compared in costs with systems requiring no timber, but it is considerably cheaper than square-setting. In comparing the costs of slicing and square-setting in a number of cases of similar ground, the cost of labor in slicing was 65% of the cost in square-setting, timber 72% and air 57%. Besides being cheaper, this method has the advantage that a small block of ground can be made to produce a large tonnage in a short time after slicing has been started. Nearly all the holes drilled are down holes on which a "plugger" drill can be used, and there is practically no mucking except at the last stages.

Waiver of Trespass in Mining

By A. L. H. Street*

The defendant lessees of mining land in a lead and zinc field were misled by representations made by plaintiffs, adjoining lessees, to the effect that they believed their shaft was about the center of their tract. The defendants were thereby induced to sink their own shaft in a place convenient for mining a strip of ground believed by both parties to belong to defendants. This, however, did not prevent the plaintiffs, who made the representations innocently, from afterward enjoining mining of the strip in question by the defendants, on discovering the true boundary line. But in reaching this decision, the Springfield, Mo., Court of Appeals holds that the plaintiffs are not entitled to recover damages for ore extracted from the strip, it appearing that they did not act promptly after discovering the trespass. (Childress vs. Flynn, 181 Southwestern Reporter, 584.)

The decision recognizes the legal principle that an owner or lessee of mining ground may estop himself from being entitled to equitable relief against a trespass by an adjoining owner, where he has misled the latter through misrepresentations as to the location of the division line, if the misrepresentations be made with intent to deceive or through gross negligence. The court declares, however, that the principle cannot be extended to an innocent misrepresentation such as was found had been made in this case.

*Attorney at law, 829 Security Building, Minneapolis, Minn.

Borax Consolidated, Ltd.

The net profits of Borax Consolidated, Ltd., at present the dominant interest in the borax trade, amounted to £349,357 for the fiscal year ended Sept. 30, 1915. This is about £5,000 more than for the preceding year and was only exceeded in the record year of 1913. This result, under war conditions, is considered exceptionally satisfactory. Last year it was assumed by the chairman that the loss of trade in the Central Empires of Europe would seriously affect the business of the company. There was, however, a continually increasing demand in Great Britain and Allied countries, and also in neutral countries, especially for the refined borax and boric acid. In the United States there was a decided increase in the demand for package goods for the household—especially for borax soap. The price for borax in Great Britain was £25, and for boric acid £43 per ton at the date of the company's meeting, Feb. 18, 1916; in Germany the chairman reported that these prices were £100 and £130 respectively.

The properties in Asia Minor, according to the most recent reports, have not been damaged. The mines in the Panderma district are shut down, and the American engineer in charge is living there now with his wife and children, unmolested by the Turks; he was arrested soon after the beginning of the war, but the inervention of the American Ambassador in Constantinople secured his release, and he was permitted to return to the mine. Supplies are being drawn from the company's deposits in other parts of the world, though operation of the South American properties was restricted by inimical legislation.

In the United States, the Death Valley R.R. was completed, opening up a new group of deposits of raw material, and a large amount of ore was transported to the calcining works. Managing Director R. C. Baker, in replying to a stockholder, said that the report that America was producing potash and borax at Searles Lake was a misstatement. The directors of the company were advised that these salts could not be economically separated at the prices that ruled in normal times, and even if they could be, a subsidiary company of Borax Consolidated owns part of Searles Lake and is the only company that at present possesses a recognized title to any part of the lake. Mr. Baker is coming to the United States soon, to look into the question of potash-borax production at Searles Lake.

Manganese Ore of High Grade is reported discovered in South Australia, about 75 mi. from Port Augusta. The deposit is believed to be large.

Dredging and Hydraulicking in 1915 by the Yukon Gold Co.*

SYNOPSIS—Increased yields were obtained in Alaska and California by the Yukon Gold Co. last year, but the returns from the Dawson field declined. New placer areas acquired in Trinity County, California, and in the Ruby district, Alaska.

The net operating gain of the Yukon Gold Co. in 1915 was $2,099,374—about $200,000 less than in 1914. The decrease in the yield was about equally divided between the dredging and hydraulicking operations in the vicinity of Dawson; the Iditarod dredge in Alaska and the California dredging operations both returned a larger amount of gold in 1915 than during the previous year.

New Dredging Areas in Alaska and California

The Yukon Gold Co. acquired in 1915 additional placer properties in Alaska and California. The estimated gross gold content of these new placers, according to the company's annual report, is $3,800,000 and the estimated net profit about $1,500,000—approximately the same net profit as estimated for the Yuba River and Butte Creek properties added to the company's holdings during the previous year.

The ground acquired in Alaska last year was a group of claims on Greenstone Creek, in the Ruby district. This property consists of about 100 acres suitable for dredging, the proven portion of which contains approximately 600,000 cu.yd. and an estimated gold content of $800,000. A 3½-cu.ft. steam-driven dredge was shipped to Ruby and is expected to be ready for operation early in the coming season.

The company acquired, by lease on certain portions and by option on others, holdings of the Trinity Development Co. on Coffee Creek and Trinity River in Trinity County, California. The leased property embraces over 400 acres, containing approximately 21,000,000 cu.yd. of gravel having an estimated gold content of $3,000,000. A 9-cu.ft. steel dredge has been ordered for the Trinity property. The plan for working the Yuba property, acquired in 1914, has been approved by the United States Army Engineers, and a similar 9-cu.ft. dredge with steel hull and superstructure, is now in process of manufacture; hauling will be begun in the spring as soon as road conditions permit.

The three California dredges operating on the American River, Feather River and Butte Creek handled in 1915 about 3,818,126 cu.yd. of gravel for a yield of $437,852. The average cost for the three dredges in California was 4.51c. per cu.yd., including depreciation. The American River dredge yielded a net profit of $213,976, or 78% of the operating profit of the California dredges. The Butte dredge met with numerous delays on account of the presence of boulders.

In the Yukon the seven Dawson dredges began operation on May 15 and ran until Oct. 15, the season being 11 days shorter than in the previous year. The average length of the dredging season was 147 days, during which the dredges operated 88.1% of the possible time, digging 5,041,075 cu.yd. for a yield of $2,456,597, or an average of 48.73c. per cu.yd. The average cost per cu.yd., including depreciation, was 26.46c., a slight reduction over the previous season. The yardage dug in 1915 was greater than during the previous season, but the areas dredged were not originally as high-grade and had been more largely mined by the old methods—principally drifting. The reduction in the gold content from these causes amounted to 5.48c. per cu.yd. The thawing cost in 1915 was practically the same as during the previous year. During the season a total of 380,430 sq.yd., or 64.7% of the ground handled, had to be thawed by steam.

Dredge No. 3, which finished its work on Bonanza Creek, is being moved to Bear Creek, where it will be rebuilt during the coming season and should be in commission about Aug. 1. Dredge No. 9 has completed its work on El Dorado Creek and will be dismantled preparatory to moving.

The hydraulicking operations of the company in the Yukon produced $412,535 from 3,031,647 cu.yd. The working cost was 7c. per cu.yd. exclusive of depreciation of main ditch—a decrease of 0.6c. per cu.yd. compared with the previous season. The total water used amounted to 494,755 miners' inches, as compared with 519,834 in 1914. The duty of the water was 6.13 cu.yd. to the miners' inch. The Bonanza pipe-line system, which carries water across Bonanza Creek to the upper group of mines, was raised during the season to provide storage for tailings. A tunnel is being driven to attack the gravel deposits on Oro Fino Hill at about the center.

The Twelve Mile water system was operated from May 4 to Oct. 4 inclusive, a total of 154 days. The aggregate delivery was 489,120 24-hr. miners' inches. The average daily delivery was 3,176 miners' inches. The ditch was operated for 95.1% of the possible time.

Excellent Results From Iditarod Operations

The Iditarod dredge in Alaska began operations on May 4 and closed down on Nov. 17. During this operating season of 196 days, the dredge handled 926,956 cu.yd. for a gold return of $845,998, an average of 91.3c. per cu.yd. for the year. The average cost, including depreciation, was 38.7c. per cu.yd., which was lower than in 1914 by 11.5c. per cu.yd. The yardage handled in 1915 was 258,219 cu.yd. greater than during the previous season. The dredge operated 91.64% of the possible time and averaged 4,717 cu.yd. per day. The daily output of the dredge was 1,216 yd. more than during the 1911 season and was due to better dredging conditions and to improvement in the handling of sands. The percentage of naturally thawed ground increased, only 49,953 sq.yd., about 36%, having to be thawed by steam. Sand elevators were installed on the Iditarod dredge during the year to replace the pumps previously in use for this purpose.

A summary of the operating results in the various districts is given in an accompanying table. Deductions from the total income amounted to approximately one million dollars, including royalties, $542,241; amortiza-

*Abstract of the annual report of the Yukon Gold Co. for 1915, by O. B. Perry, consulting engineer and general manager.

tion, $248,036; interest charges, general expense and examinations, $245,803. It is interesting to note that according to the statement of Dec. 31, 1915, the company has over $400,000 tied up in "bullion in transit." Under the heading of equipment, which includes the cost of ditches, dredges, pipe lines, etc., the company schedules $7,039,902. The depreciation account now amounts to $1,223,740. Last year the amount written off for depreciation and amortization, either directly or through operating costs, was $483,782. Dividends were paid amounting to $1,050,000 during the year, making a total of $7,583,110 paid in dividends to date.

OPERATING RESULTS, 1915—YUKON GOLD CO.

	Cu.Yd.	Production	Working Costs	Operating Gain
Dawson dredges...	5,041,075	$2,456,597	$1,333,908	$1,122,689
Dawson hydraulics	3,031,647	412,535	243,247	169,288
Iditarod dredge....	926,956	845,998	358,407	487,591
California dredging	3,818,126	437,852	172,118	265,734
Miscellaneous operations	.....	56,827	2,755	54,072
Total operations.	.....	$4,209,809	$2,110,435	$2,099,374
Nonoperating income	.....	.....	.....	21,657
Total income....	.....	.....	.....	$2,121,031

As a result of the $5,000,000 loan of the Guggenheim Exploration Co., the dredging company liquidated its other floating indebtedness and has been provided with a working capital of about $2,700,000, with which to acquire and equip new properties recommended by its engineers. The Guggenheim Exploration Co. having instituted proceedings for its dissolution, the Yukon-Alaska Trust has taken over the interest of the Exploration company in the Yukon Gold Co.

Differential Flotation

One of the difficulties about flotation is the trouble encountered in separating the various minerals in the concentrates. For example, it is difficult to separate iron minerals from zinc minerals, while the combination is extremely undesirable at the smelting plants. This important work is done by selective flotation methods, operating on the concentrates formed and some experimenters have been able to make a fair separation by a series of cleaning flotations.

Recently it has been suggested that a division of the minerals might be made by the use of the magnetic-separating machines. In several instances magnetic separators are used in connection with flotation, but usually before floating and on the coarsely ground ore. An example of this may be found in the Cœur d'Alene district. Recently the Campbell magnetic separator has been tried in an application to flotation concentrates.

An iron-zinc flotation concentrate has been separated successfully in this way. The grains of concentrate were fine, but not too fine to be roasted and separated magnetically. In another case concentrates were rich in copper and zinc, but in an exceedingly fine state that could not be roasted. In this case success was attained by crushing the ore first to 40 mesh, separating it magnetically to remove pyrite and chalcopyrite, after roasting. The tailings from this operation, containing all the zinc, were reground and floated.

Some variation of this treatment may be applied in other cases. Sometimes the iron will carry silver or gold, when the careful separation is even more important. The question of separation of minerals in concentrates is one of importance, and its solution makes an appreciable increase in the value of the product.

Mine Sampling and Mapping

By Robert J. Burgess*

Mine sampling is probably the most slighted branch of the mining industry today, owing to the fact that, firstly, it is a fixed overhead expense, and secondly, necessity has not as yet forced many of the big producers to go back after ore they never had any idea a few years ago that they could handle. What wouldn't some mine managers give for a set of maps of their old stopes with the assays for gold and silver written in each set?

A stope always follows at each floor a contour that is determined by the limits to which the property is being mined during the period at which the stope is worked. From the end sets of these plans, longitudinal sections of the abandoned portions of the mine can be built up, which will carry all the information necessary to make an estimate at any time. Stope plans are also exceedingly valuable in planing work to be done in "old fill," as it is invariably the case, where rich ore was previously mined, that the fill will be correspondingly of higher grade. This is especially so where the first work was done by contract labor and the ore mined was paid for by the set. Most mines while operating, however, do not collect and file these data, and when a mine changes hands or is reopened, it is the exception rather than the rule to find complete assay and geological plans and sections. This of course makes an examination of the mine necessary, which can only be completed in the parts of the mine open at the time of the examination while all of the old workings are either not considered or their ore is vaguely estimated from notes taken from old assay books made at the time the work of developing the faces was done.

In Mexico, where labor is cheap, several of the larger properties have seen fit to organize sampling departments, headed by technical men, to collect and arrange data for present and future use. One of the big producers in Mexico has developed a mine-mapping and sampling system which has no equal in the entire country.

Organization of Sampling Crew

This company employs a chief sampler, who is responsible for the entire work of the department; from 15 to 20 Mexicans help him. As a rule there are three Mexicans in a sampling party—the sampler and two helpers. The party is provided with a pick for soft ground, an 8-lb. hammer and moil for hard rock, sacks enough to cover their run, carbide lights, a block of colored paper for numbering the samples, a notebook on development work, a cross-section book for the stopes, and a thirty-meter tape for laying off their samples. Each party uses a different colored block of paper and a different serial number to facilitate a quick separation of each set of samples in the grinding room. The entire crew cuts between three and four hundred samples of all classes and descriptions each day, and turns over its results to the mine and the office at 7 o'clock the following morning.

Two sets of reports are delivered to the office of the mine superintendent every morning before the mine captains go down. The first report, as at most mines, consists of a list of the previous day's development faces and a list of the assays from the various chutes pulled

*Chief sampler, Esperanza Mining Co., El Oro, Mexico.

during the previous day, with the number of cars from each chute inserted opposite the assay. The second set of reports consists of a set of stope books, one for every three levels, posted to date from the previous day's stope samples by a night man in the sampling office. Three sets of these books are kept in use all of the time. One is used by the sampler and contains only the numbers of the samples cut. From this book as a key the night man plots in the new sets with their assays into the two other sets of books. One of these sets is kept for the office and the other belongs to the mine. It is from the list of chute samples and their corresponding stope-assay plans that the mine captain lays out his work for the day, and if he is any good at all, he can generally put just about what the mine superintendent wants into the bins.

All of the development samples are cut by the same sampler. They are cut at meter intervals and referenced to the engineers' survey plugs. This man reports the width of the vein, its value in gold and silver and the kind of rock in the hanging and foot walls, making special notes of any change. These results are posted monthly on the geological plans of the different levels and upon longitudinal sections of the different veins in the mine. The results are also copied into an assay book, so that dates are always available in looking up back information. The sampling department picks up the mine geology in connection with the development work and records it upon the assay and geological plans of the different levels. Reductions from these level plans are transferred to glass, and a working model of the mine is kept up.

The chute samples, which consist of a small shovelful of ore cut at the chute as the car is being drawn, are collected once in 24 hours by a sampler and his helpers. Composite samples of each level are made daily by cutting a shovelful from each car as it is being dumped into the bin, and throwing it upon a split-sampler at the station. From these samples the mine superintendent is able to direct the daily work of his captains.

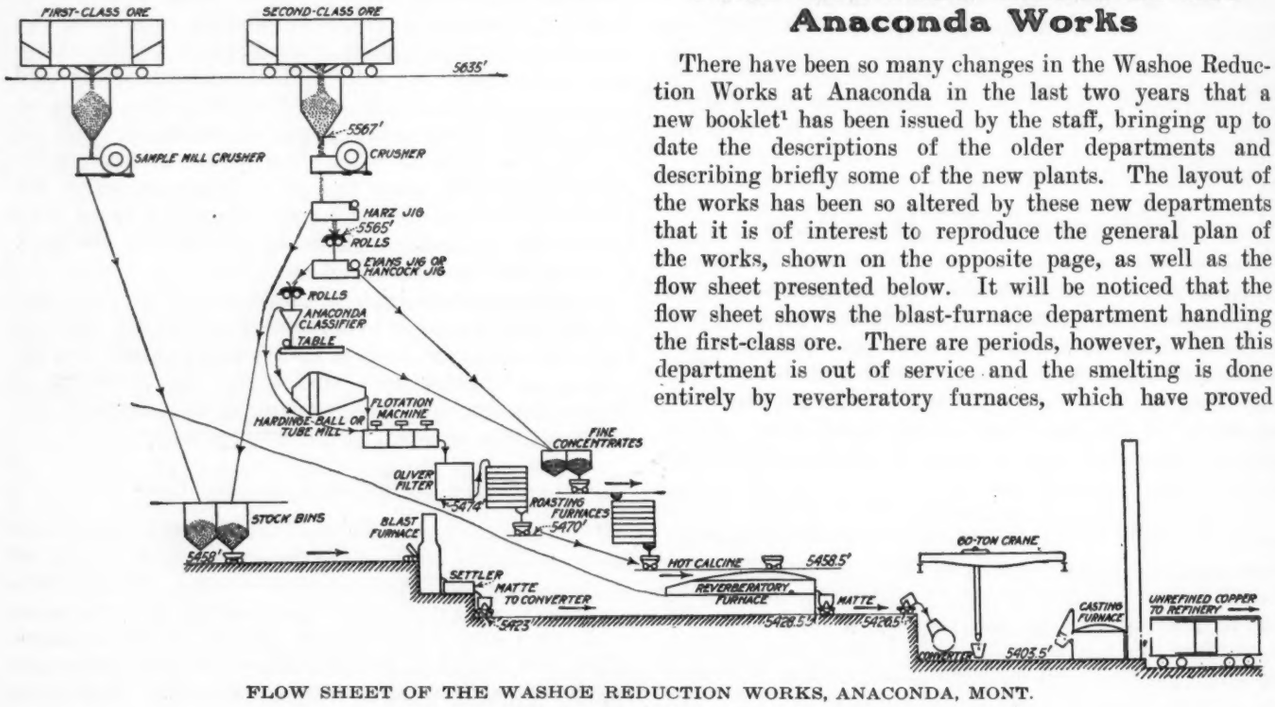
In the rich oreshoots, which are generally less than a meter in average width, the stope backs are measured accurately four times a year and samples are cut at meter-and-a-half intervals on the backs. These samples, together with the development assays, are combined on longitudinal sections of the shoot. From these sections an accurate estimate of the tonnage and value of the ore in sight can be made at any time.

The sampling crews are under ground seven hours and in the office one hour each day, the last hour of the afternoon being spent in making up the lists for the following morning, so that when the returns come from the assay office, the night man has only to insert the assays after their proper number. The helpers devote this time to getting and drying their sacks, having their picks and moils sharpened, cleaning their lamps and restringing their sacks.

The duties of the chief sampler on work of this kind are to generally supervise the cutting and grinding of the samples and map the results obtained. As a rule, this work can be satisfactorily done by spending half of the time in the mine and the other half in the office.

Plan and Flow Sheet of the Anaconda Works

There have been so many changes in the Washoe Reduction Works at Anaconda in the last two years that a new booklet[1] has been issued by the staff, bringing up to date the descriptions of the older departments and describing briefly some of the new plants. The layout of the works has been so altered by these new departments that it is of interest to reproduce the general plan of the works, shown on the opposite page, as well as the flow sheet presented below. It will be noticed that the flow sheet shows the blast-furnace department handling the first-class ore. There are periods, however, when this department is out of service and the smelting is done entirely by reverberatory furnaces, which have proved more economical since the introduction of coal-dust firing and flotation concentration.

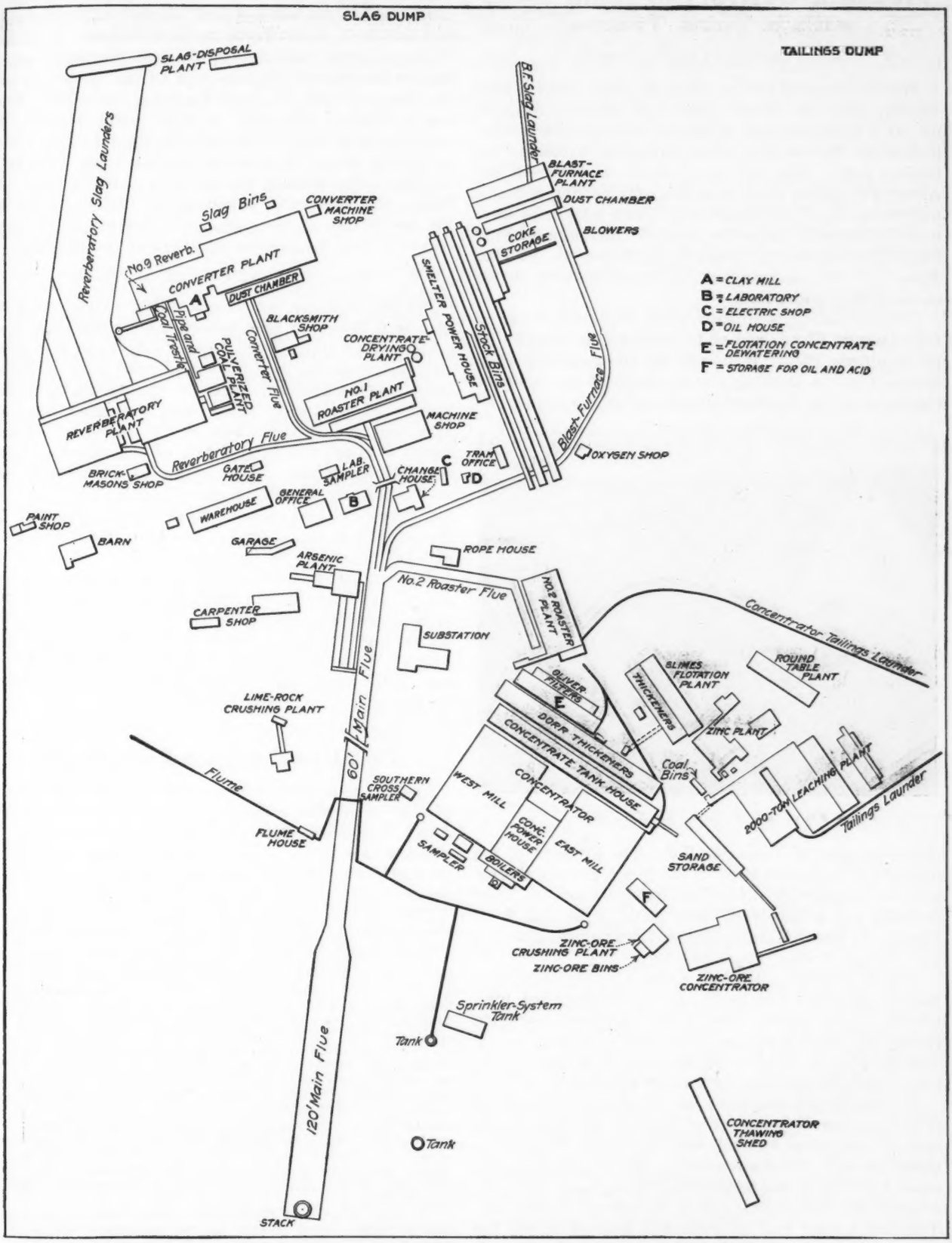


FLOW SHEET OF THE WASHOE REDUCTION WORKS, ANACONDA, MONT.

Copyright, 1916, by Anaconda Copper Mining Co.

Among the important new departments, shown in the accompanying plan of the works, are the concentrator additions to dewater the flotation concentrates, the slimes flotation plant, the round-table plant, tailings leaching department and the No. 2 roaster plant, besides numerous auxiliary departments required by the new metallurgical developments, such as the coal-pulverizing building for the reverberatory fuel, sundry sampling mills and additions to mechanical shops.

[1] "A Brief Description of the Washoe Smelter." By the staff of the Anaconda Copper Mining Co. Copyright, 1916, by the Anaconda Copper Mining Co.



LAYOUT OF THE WASHOE REDUCTION WORKS, ANACONDA, MONT.

The accompanying plan of the Washoe works shows the situation of the new departments that have been added during the last few years. Prominent among these new plants are the new flotation units, including the thickening and filtering departments for dewatering the concentrates, the slimes flotation plant, round-table plant, tailings leaching plant, zinc concentrator and subsidiary departments, No. 2 roasting plant, etc. The above illustration is from "A Brief Description of the Washoe Smelter," a new booklet issued in January, 1916, by the staff at Anaconda, and copyrighted, 1916, by the Anaconda Copper Mining Co.

Hauling California Lead Ores with a Yuba Tractor

SAN FRANCISCO CORRESPONDENCE

Transportation of lead ores from Ubehebe district, Inyo County, Calif., to Bonnie Clare, Nye County, Nev., 52 mi., at a maximum cost of $8 per ton, has been accomplished by the use of a Yuba ball-tread tractor as the hauling power. The ores were from W. W. Waterson and Archie Farrington under a contract for hauling 500 tons undertaken by F. A. Campbell. Three trial trips were made in December under the personal supervision of Fred Pursell, acting for the Yuba Construction Co., of San Francisco, who manufacture ball-tread tractors at the shops at Marysville, Calif.

Ubehebe district is situated in the northeast corner of Inyo County, 60 mi. east of Laws, a shipping station on the Southern Pacific R.R., and 52 mi. northwest from Bonnie Clare, a shipping station about 25 mi. south of Goldfield, on the Southern Pacific R.R., at the junction

A FEAT BY THE YUBA TRACTOR

of the Tonopah & Tidewater R.R. The situation of the district on the eastern slope of the Sierra and the shorter haul to Bonnie Clare make the latter station the more desirable and economic shipping point. The road from Ubehebe to Bonnie Clare is generally downgrade, although there are some steep upgrades.

The first trip from Ubehebe to Bonnie Clare was made with an old wagon with heavy running gear and bed, high wheels, narrow double tires, badly weathered, but with spokes in fairly good condition. This wagon had a capacity of 8 to 10 tons. It was hooked on next to the tractor and the farm wagon used as a trailer.

The big wagon cut badly in all soft places, making it necessary to drop the trailer twice on the first day in order to get out of bad holes; so that little progress was made that day. On the second day, after being out 2 hr., about 1 ton of ore was taken off the front wagon and good progress was then made during the balance of the day. This left a total load of about 8½ tons—6 on the big wagon and 2½ on the small wagon; and with this amount the haul was made through to Bonnie Clare.

Before starting for the mine to make the second trip, the big wagon was abandoned and a makeshift string of wagons was assembled, composed of one all-steel truck with roller bearings and 4-in. tires (capacity about 4 tons), one wooden-wheeled farm wagon with narrow tires and one small wagon (same as used on first trip). The 3 wagons were loaded—3½ tons on the steel wagon next to the tractor, 2¾ tons each on the two others and an excess of 500 lb. divided among the three. This was a total of 9¾ tons on three small wagons. It proved a much lighter haul than the 8½ tons with 6 tons on one big wagon. The second trip was made (104 mi.) in about 45 hr. running time, in spite of the fact that the boxing was turning in a hub on the middle wagon for the last 25 mi. of the trip, and numerous breakdowns occurred from the inferior condition of the wagons.

CAPACITIES AND COST OF THE WORK

For the third trip two wagons with a carrying capacity of 5 to 6 tons each were substituted for the three used on the second trip. These wagons had 5- and 6-in. tires and were reconstructed from second-hand parts of Studebaker wagons gathered up from various places in the vicinity of Goldfield. They were connected up with short tongues and with a horn on the tractor. Each was loaded with approximately 5 tons of ore, making a little over 10 tons net load. This string went through with less trouble than on the other trips and carried more than ¼ ton greater net load than the three-wagon string used on the second trip and about 1½ tons greater net load than with two wagons on the first trip.

The distillate fuel used on this job was figured at 17½c. per gal.; cylinder oil, 60c. per gal.; the driver at $6 per shift; depreciation, $5 per shift. The actual cost of hauling the lead ores from Ubehebe mine to Bonnie Clare (52 mi.) on the second and third trips was $8 per ton. A man with teams had previously abandoned the same hauling at a price of $15 per ton.

Publication and Patents

Operating engineers are occasionally confronted by the question of whether publication of a description of a new device will affect their right to secure a patent. In response to a recent inquiry on this subject, we referred the matter to J. F. Brandenburg, a patent attorney, of 2 Rector St., New York, who has replied as follows:

Publication is no bar to the obtaining of a valid United States patent, provided the publication is not more than two years prior to the filing of the application.

In most foreign countries the general rule is that applications should be filed before the invention has been fully described or illustrated in public prints. In the case of countries, however, which have adhered to the International Convention, previous publication will not invalidate provided the applicant files his foreign applications within one year of lodging his United States application in the Patent Office at Washington. That is to say, the law in the United States allows the applicant to publish his invention before filing his application, and if he thereafter files foreign applications within the period of one year from the United States filing, his foreign patents cannot be invalidated by proof of the publication. Filing foreign applications under the provisions of the Convention requires certain special formalities and entails additional expense. The Convention countries are: Australia, Brazil, Mexico, and all of the countries of Europe except Russia.

In other South and Central American countries, in Russia and in South Africa patents can be invalidated by proof of prior publication, the International Convention not applying.

Canada is not a party to the International Convention, but the Canadian law contains no provision as to prior publication, except with respect to patent publication. If a patent has been obtained in another country, a Canadian application should be filed within one year of the issue date of the prior patent.

Relative Costs of Coal and Oil Fuels*

SYNOPSIS—The chart shows the relative cost of dry fuels and oil fuels in terms of either the cost per boiler-horsepower-hour, or of the evaporation from and at 212 deg. F. produced at a cost of 1c. It is useful in connection with the splendid charts for coal alone, recently published in the "Journal."[1] The efficiency of boiler and grate is taken strictly to mean the average over-all fuel efficiency and has nothing to do with the evaporation that might be obtained when the plant is "spruced up."

In plotting the curves for oil it was found expedient to assume a "typical" fuel oil. The average B.t.u. per gallon on four oils that vary greatly in character and gravity was found to be 142,214, and a gallon of this oil was found to weigh 7.4849 lb., corresponding to approximately 26 deg. Bé. gravity.

The coal and dry-fuel curves, although plotted for convenience on the same set of axes, must be looked upon as independent of the oil curves.

The latter were plotted from the following formula:

$$\text{Fuel cost in dollars per b.hp.-hr.} = \frac{(33{,}479\ B.t.u.) \times (\text{cost of oil per gal. in dollars})}{(B.t.u.\ \text{of oil per gal.}) \times (\text{over-all efficiency of boiler and furnace})} \quad (1)$$

in which 33,479 B.t.u. is the amount of heat required to be usefully absorbed to produce 1 b.hp. and in which 1 b.hp.-hr. is taken to mean an evaporation from and at 212 deg. F. of 34½ lb. of water per hr.

The formula for coal is approximately the same:

$$\text{Fuel cost in dollars per b.hp.-hr.} = \frac{(33{,}479\ B.t.u.) \times (\text{cost per gross ton burned})}{(B.t.u.\ \text{per lb. of coal available}) \times (2{,}240\ lb.)} \quad (2)$$

The values of the cost per b.hp.-hr. were plotted against different prices per gallon and for over-all efficiencies ranging from 55 to 100%. The cost of 1 b.hp.-hr. will be found along the under side of X axis; on the upper side may be found the number of pounds of water, which, at a cost of 1c., may be evaporated from and at 212 deg. F.

The evaporation from and at 212 deg. F. per lb. of oil fired may be obtained by projecting the intersection of the oil-efficiency curve with the broken curved line, called "B.t.u. of oil fuel absorbed at various efficiencies," onto the Y axis.

Example for Oil at 85% Efficiency

To find the cost per boiler horsepower-hour of oil fuel at 85% efficiency, the oil costing $0.023 per gal. burned, proceed as follows:

From the $0.023 point on the scale of costs per gallon (on the axis of Y') project parallel to the axis of X until the projection intersects the 85% oil-efficiency line. Call this point P. A perpendicular from this point to the base-line at once gives the result in either of two ways. In this case we find that the cost per boiler-horsepower-hour is $4.00635 and is equivalent to an evaporation of approximately 54.2 lb. of water at a cost of 1c.

In addition to the foregoing, by projecting to the left from the point P, find that the evaporation per pound of oil fired is approximately 16.48 lb. "from and at," and that 16,000 B.t.u. per lb. of fuel must be absorbed to accomplish this.

Let us test these answers:

$$\text{B.hp. per gal. oil fired} = \frac{(142{,}214\ B.t.u.\ \text{per gal.}) \times (0.85\ \text{efficiency})}{33{,}479\ B.t.u.} = 3.61$$

*By F. C. Fearing in "Power," Dec. 14, 1915.
[1]"Eng. and Min. Journ.," Oct. 9-Oct. 16, 1915.

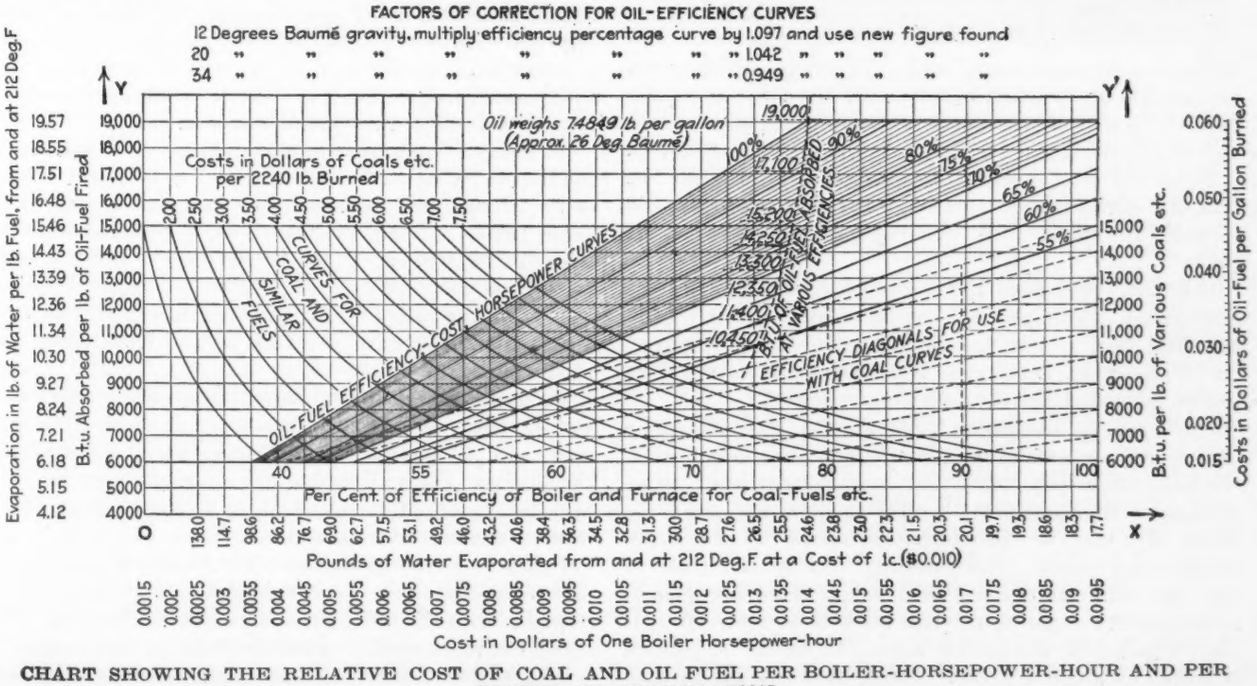

FACTORS OF CORRECTION FOR OIL-EFFICIENCY CURVES
12 Degrees Baumé gravity, multiply efficiency percentage curve by 1.097 and use new figure found
20 " " " " " " " " " 1.042 " " " " "
34 " " " " " " " " " 0.949 " " " " "
Oil weighs 7.4849 lb. per gallon (Approx. 26 Deg. Baumé)
Costs in Dollars of Coals etc. per 2240 lb. Burned
OIL-FUEL EFFICIENCY-COST HORSEPOWER CURVES
CURVES FOR COAL AND SIMILAR FUELS
B.t.u. OF OIL FUEL ABSORBED AT VARIOUS EFFICIENCIES
EFFICIENCY DIAGONALS FOR USE WITH COAL CURVES
Evaporation in lb. of Water per lb. Fuel, from and at 212 Deg. F
B.t.u. Absorbed per lb. of Oil-Fuel Fired
B.t.u. per lb. of Various Coals etc.
Costs in Dollars of Oil-Fuel per Gallon Burned
Per Cent. of Efficiency of Boiler and Furnace for Coal-Fuels etc.
Pounds of Water Evaporated from and at 212 Deg. F. at a Cost of 1c. ($0.010)
Cost in Dollars of One Boiler Horsepower-hour

CHART SHOWING THE RELATIVE COST OF COAL AND OIL FUEL PER BOILER-HORSEPOWER-HOUR AND PER FACTOR OF EVAPORATION

A gallon of oil, however, costs $0.023, which, divided by 3.61, equals $0.00637, the cost of 1 b.hp.-hr., which checks closely the result found by use of the chart.

As the heat value of coal varies between wide limits and is not a comparatively stable quantity, as with oils, the coal curves had to be plotted so as to represent various prices per long ton as burned, instead of the various efficiencies taken for the oil curves. The coal efficiencies are then obtained from the set of supplementary curves, as explained hereafter. To facilitate operations it is assumed that the coal contains only those heat units usefully absorbed at the given efficiency; thus a coal containing 15,000 B.t.u. and burned at 60% efficiency is assumed to be equivalent to a coal containing only 9,000 B.t.u. and burned at 100% efficiency.

The coal curves are plotted against B.t.u. per pound on the scales for coal, which will be found on the right of the chart along the inside of the Y' axis.

Let us work an example:

Assume that we are burning a coal containing 13,000 B.t.u. at an over-all efficiency of 60%, the coal costing $3.50 per long ton consumed. Starting from the 13,000-B.t.u. mark on to Y' axis, follow the light dotted slanting line until it intersects the 60% perpendicular from the base line. From the point thus found, project right or left, as may be necessary, to the $3.50 coal curve. Call this point P'.

The perpendicular to the base-line from P' indicates that the cost of 1 b.hp.-hr. is approximately $0.0067, in which the last figure is estimated. This we also find is equivalent to an evaporation of approximately 51 lb. of water "from and at," at a cost of 1c.

By carrying the projection from the point P' over to the Y axis, we find that the evaporation "from and at" is 7.23 lb. and that approximately 7,790 B.t.u. must be absorbed.

Check the accuracy of this result:

$$\frac{(2{,}240\ lb.) \times (13{,}000\ B.t.u.) \times (0.6)}{(33{,}479\ B.t.u.)} = 521\ b.hp.$$

produced from one ton of coal. Therefore, dividing the cost per ton by 521, find that the cost of 1 b.hp.-hr. equals $0.00671 and that the chart result represented an error of 7 in the third place of digits, or only a trifle over 1%.

From the two cases of oil and coal set forth, we see that for the assumed condition the fuel cost per 100 b.hp.-hr. for oil fuel will be 63½c., as against 67.1c. for coal.

Oil fuels other than the one plotted require, after the evaporation "from and at" has been found directly from the chart, that a correction be applied to the oil-efficiency curve first used, before the boiler-horsepower-hour costs can be estimated, for the following reasons:

Oil is sold by the gallon. Some heavy oils yield more heat units per gallon than the lighter ones, even when the heat values per pound may be somewhat less. Some recent investigations have tended to show that even the heavy oils may be considered as having 19,000 B.t.u. or more per pound. Consequently, oils heavier than 26 deg. Bé. (the oil plotted) will weigh more per gallon, and therefore a gallon of such oil will be more efficient than a gallon of the lighter kind. It should be pointed out that although a greater evaporation per gallon may be obtained from heavier oils, yet no greater evaporation per pound will necessarily be effected.

So, after having found the evaporation per pound from and at 212 deg. F., multiply the particular efficiency curve so far used, by the nearest factor of correction, for the oil being figured on. (These are given in the center of the chart.) All further calculations should be made in the usual manner on the new efficiency curve thus obtained.

It frequently happens that the data collected at a plant on which to base a comparison show coal ahead of oil fuel from an economic standpoint, where all the signs pointed the other way. If the engineer making the investigation is convinced that the coal figures furnished by the plant engineer represent the true average conditions, then nothing more need be said; but if the "efficiency we are getting with coal" does not take into account banked fires and the low points in the efficiency curve as well as the high spots, then there is only one thing to do, and that is to take observations for a long enough period to insure the accurate determination of the average over-all efficiency with coal. Experience with oil fuel then enables the engineer to decide what average over-all efficiency can be looked for with liquid fuel at the plant in question. The rest is but a matter of a few moments' use of the chart.

Large Output of Antimony Ore

Antimony prices in 1915 were probably the highest known since the metal became a regular article of commerce. The high prices led to the largest production the United States has made, and probably the same statement is true for the world's production. According to preliminary figures collected for the United States Geological Survey by Frank L. Hess, the production of antimony ores in the United States is estimated to have been about 5,000 tons, containing 2,000 tons of antimony valued at about $325,000. The largest previous domestic production was in 1892, when 150 tons of metal was produced in San Francisco from Nevada ores and 380 tons of ore carrying 55% of antimony was exported. Practically all operations of 1915 were new, most were small, and they were widely scattered, so that it is difficult to obtain close figures immediately after the close of the year.

In the fall American antimony appeared on the market for the first time in many years. At first it sold slightly below Chinese and Japanese, but was soon quoted at the same price. Miners and smelters, apparently thinking that the high prices would be temporary, did not begin production as quickly as they otherwise might have done, but before the close of the year properties in Alaska, California, Idaho, Nevada, Oregon, Utah and Washington were producing.

From Alaska, according to data collected by Alfred H. Brooks, about 685 tons of stibnite ore carrying 58% antimony was produced in the Fairbanks district, from properties on Eva, Vault, Treasure and Chatham Creeks. It is reported that 132 tons was shipped from Nome, but it seems probable that more was mined.

Prices for ores ranged from $1 to $2.10 per unit of antimony. At first, only ores carrying 50% or more antimony were in demand, but before the close of the year 20% ores were being shipped from Nevada.

The largest production was made from deposits near Wild Rose Spring, on the northwest slope of Telescope Peak in the Panamint Range, California. These deposits

have been known for many years, but have been too far from railroads for profitable exploitation until last year, when prices were high, and a branch railroad was built to Trona on Searles Lake, within about 25 mi. of them. The deposits contained considerable antimony ochre as well as stibnite and were mined by the Merchants Finance Co. (Western Metals Co.). The same company operated deposits 30 mi. northeast of Mojave, and 10 mi. from the Southern Pacific R.R. at Neuralia, in Kern County. Other deposits were mined in California at many points in Kern County, in the eastern end of San Benito County, and on Moore's Flat, near Grass Valley. In Nevada considerable quantities were mined at many points, mostly in the northwest quarter of the state, with Lovelock as a center, but ranging from Pass Cañon in the Pine Forest Range southward to the vicinity of Tonopah and eastward to Joy.

Oregon, Washington and Idaho produced small tonnages of ore, and in Arkansas a company was organized to work old properties west of Gilham.

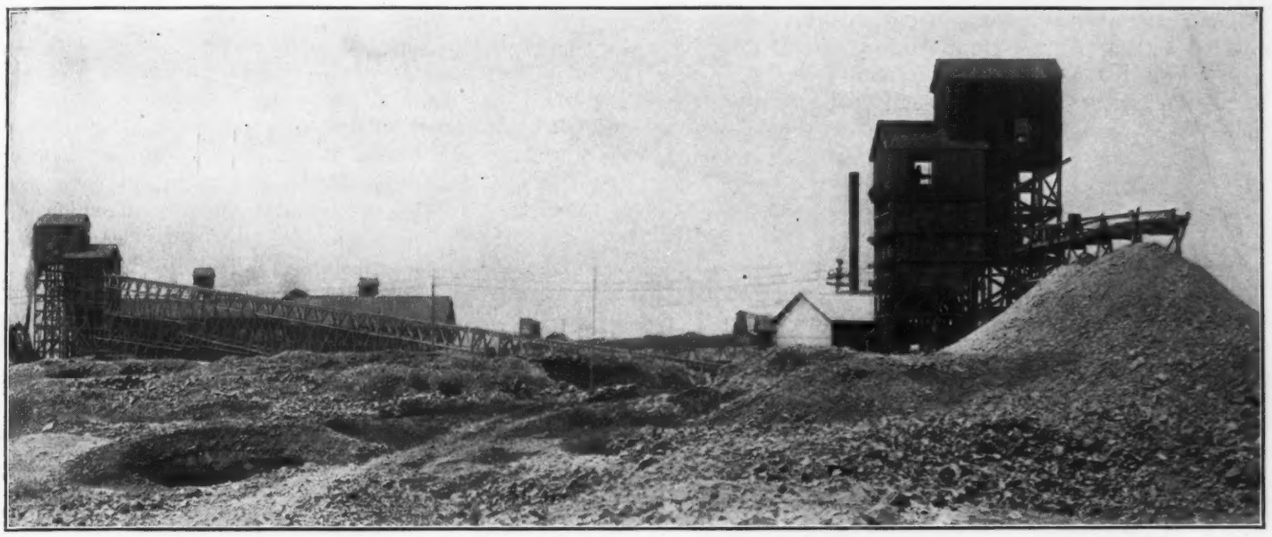
The Chapman Smelting Co., of San Francisco, which had been idle for a number of years, again started the smelting of antimony ores. The company mined ore at Bernice, 60 mi. east of Fallon, Nev., and brought ores from other points in the Western States, Alaska and British Columbia. The Merchants Finance Co. built an antimony smelter at Industrial Harbor, Los Angeles. Besides operating California mines, the company operated mines in Nevada and bought ores from the Western States, Alaska and foreign countries. The Antimony Smelting and Refining Co., of Seattle, started a plant at Van Asselt the last of the year and made oxide, but metal is to be smelted also. The International Smelting Co. bought ores to be smelted at its South Chicago plant. The Great Western Smelting and Refining Co., of Chicago, and the Pennsylvania Smelting Co., of Pittsburgh, have also smelted some ores. The Magnolia Metals Co. found so much difficulty in obtaining needed supplies of antimony at a reasonable price that it bought and mined ores in Nevada, smelting them at Brooklyn. Harshaw, Fuller & Goodwin Co., of Cleveland, was in the market for pure ores from which to make antimony salts, heretofore made from Chinese "crude antimony," produced by the liquation of the stibnite ores in double-pot furnaces.

The tendency has been for some companies to go to an expense for mine development, machinery and mills not wholly warranted by the circumstances. The present high prices are necessarily temporary. The Chinese deposits are extensive and worked by cheap labor, and other deposits are being developed in other parts of the world; and as soon as the war is over, and possibly before, prices will probably drop to a level with, or close to, those which prevailed in 1914.

New Granby Concentrator

By Lucius L. Wittich*

The completion of a large concentrating plant at Granby, Newton County, Mo., built by the Granby Mining and Smelting Co., gives to the Granby camp the distinction of having the largest and most modern mill in the entire Missouri-Kansas-Oklahoma district. With a building 190 ft. long and 40 ft. wide, equipped with two rougher jigs, two cleaners, 15 sand tables and two double-decked slime tables, the plant can easily handle 500 tons of ore in 10 hr.



GENERAL VIEW OF KLONDIKE MINE OF THE GRANBY MINING AND SMELTING CO., GRANBY, MO.

A feature of concentration that differs from the ordinary practice of the district is the removal of the sludge water at the heads of the rougher and chat jigs, thus giving more uniformity to the concentrates taken from the jigs. This system, having been proved a success at the B. & H. mill of the Granby company, at Joplin, it was installed in the larger mill at Granby. The Granby plant, known as the Klondike mill, was constructed by the Webb City & Carterville Foundry and Machine Co. at a cost of $75,000. Electric power is used almost exclusively in the operation of the machinery in the mill and on the lease, and ultimately what little steam equipment is now employed will be replaced. To supply power for this mill the Empire District Electric Co. extended its lines to the Granby camp from a point 6 mi. to the north, where the main power lines from the White River plant are situated.

The development by the Granby company of a deep run of ore, beneath all the former workings of mines

*Joplin, Mo.

that had been situated on the same property, led to the construction of the new mill. A motor of 200 hp. runs the main mill machinery, consisting of the crusher, rolls, rougher and cleaner jigs, elevators, etc., while the sludge tables are operated by a motor of 75 hp. Two shafts are worked, one at the mill and one 600 ft. to the east and connected with the mill by an inclined tramway. At each shaft a direct-driven United Iron Works hoist, run by a 75-hp. motor, is operated. The 1½-ton cars that carry ore from the east shaft to the hopper of the mill are pulled by a direct-driven United Iron Works hoist run by a 37-hp. motor.

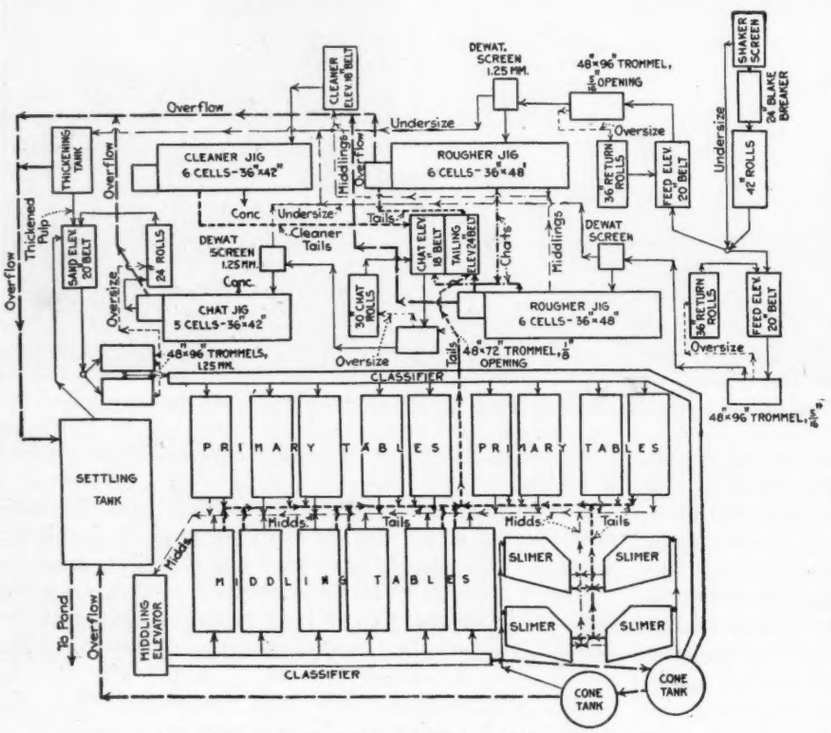
Through drill holes, each 10 in. in diameter and each situated about 8 ft. respectively from the mill shaft and from the east shaft, American deep-well double-action pumps, each with a capacity of 250 gal. per min., are operated by two 75-hp. motors. At another point, about midway between the east shaft and the mill shaft, an old drill hole has been pressed into service. Here a No. 10 Buffalo blower is situated. It is driven by a small steam engine, which is soon to be replaced by an electric motor. A down draft supplies ventilation for the mine drifts.

The compressor house is situated northeast of the mill and houses two Laidlaw-Dunn-Gordon feather-valve compressors—one 550-cu.ft. capacity and driven by a 100-hp. motor, and the other of 850-cu.ft. capacity and driven by a 150-hp. motor. A 3-hp. motor drives an American centrifugal pump that supplies the circulating water for the compressors.

All buildings on the ground, including a modern "dog house," 50x16 ft., are of galvanized iron. The "dog house" is equipped with the latest ventilating devices and shower baths. A spacious office and supply room is situated near the compressor house. The mill equipment consists of one 24-in. crusher, one set of 42-in. rolls, two sets of 36-in. rolls, one 30-in. roll and one pair of 30-in. high-speed rolls for grinding chats.

Revolving screens at the heads of both roughers dewater the ore, the sludge-laden water passing directly to the settling tanks before passing over the cells, thus relieving the rougher jigs of the task of treating a large tonnage of fine mineral values that otherwise would pass over the jigs with the coarser ore. The same dewatering system is employed at the head of the chat jig. The 15 sand tables are of Arbouthnot make, and the two double-decked slimers are made by the Deister Machine Co. Cleaned concentrates are loaded directly into box-cars and shipped to the Granby company's new zinc smeltery near East St. Louis, Ill.

Each of the shafts is 5x9 ft. in the clear and 225 ft. deep, or 5 ft. deeper than the bottom of the drifts. The ore occurs in disseminated formation, extensively shot through a light-blue chert and blocked out by more than 20 drill holes ahead of the present workings. Faces 30 ft. high are carried, and the mill recovery is slightly better than 7% blende, showing an average assay of 60% zinc, not a trace of lead and less than 1% of iron.



FLOW SHEET OF GRANBY CONCENTRATOR

Monument to Major Powell

On the rim of the Grand Cañon, in Arizona, a monument to Maj. John Wesley Powell has just been completed by the Department of the Interior. The memorial is an altar decorated in Indian imagery and supports a bronze tablet on a pyramidal base of rough-hewn stone. Fifteen steps lead up to the altar floor, from which one may gaze into the very heart of the multicolored mile-deep cañon. The structure is worthy both the rugged, forceful personality of the intrepid scientist who first passed through this terrible gorge and the titanic chasm itself.

John Wesley Powell was born at Mount Morris, N. Y., Mar. 24, 1834. Teaching school in Illinois when the Civil War broke out, he volunteered as a private and came out a lieutenant-colonel, but was always called Major. He lost his right arm at the battle of Shiloh. At the close of the war, Major Powell became professor of geology in the Illinois Normal University. His excursions into Colorado and the exploration of two small cañons of the Grand River stimulated the purpose which later shaped his final career.

His great adventure, the passage of the Grand Cañon of the Colorado, was made in the summer of 1869, the party consisting of 10 men in four boats. One of the boats was lost in the river and most of their flour destroyed, and they were on very short rations when, on Aug. 29, the remainder of the party swept out of the Grand Cañon in safety. Major Powell repeated the passage for scientific research two years later. He secured the original appropriation for geological work and finally succeeded in having the Geological Survey organized and, at his earnest solicitation, Clarence King secured as first director. He was appointed the second director by President Garfield.

Details of Practical Mining

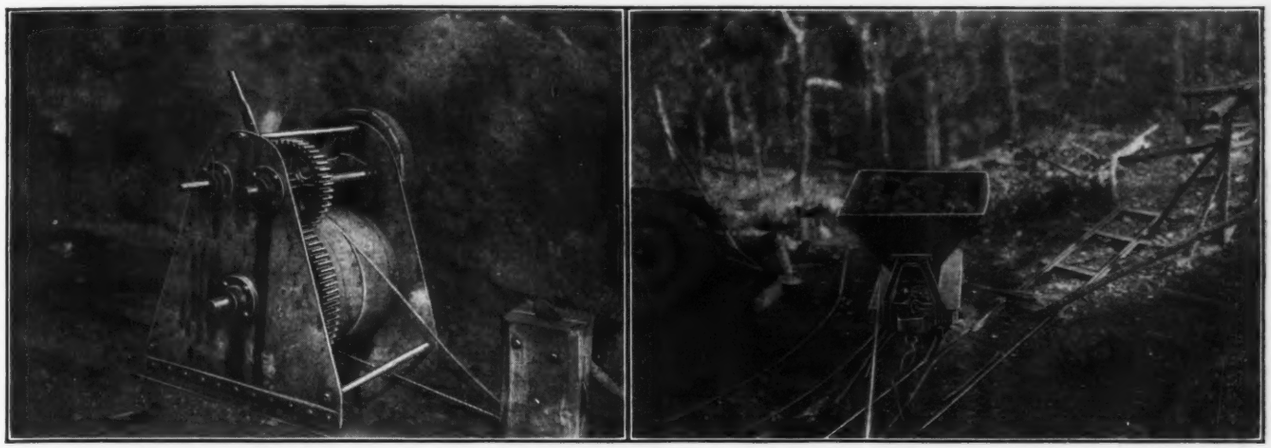
Operating a Gravity Incline with Limited Cable

By Charles Mentzel*

The mining engineer in a district far from the source of materials of construction is at times called upon to do things that would never occur to him in a more favorably situated place where a variety of equipment is at hand. The home office, having made a favorable contract, may telegraph the engineer to get out a shipment of ore on a date that seems unreasonably early to the engineer on the ground.

A situation of this sort arose at a deposit I was developing a few months ago in the tropics. It became necessary to get a shipload of ore ready in the shortest possible time, with such equipment as was available at an isolated developing property. The ore deposit was on the crest of a hill and was exposed by an opencut. At the bottom of the hill was a storage bin at the terminus of a 2-ft. gage railroad in process of construction. The slope of the hill was 19°, or about a 34% grade.

After looking up the materials available, I decided that a 550-ft. gravity incline was the most feasible to install. There was on hand a limited amount of ⅝-in. wire rope, sufficient light rail for a three-rail system and a geared hand winch with a drum 8 in. in diameter. The blacksmith shop was equipped with the usual smithing tools, a set of taps and dies and an ordinary hand-power post drill.



CONVERTED WINCH AND 1-TON DECAUVILLE CAR AT HEAD OF INCLINE

A 550-FT. GRAVITY INCLINE IMPROVISED IN THE TROPICS

The drum of the winch was lagged with two pieces of hardwood, bolted together through the drum, to bring the diameter up to 2 ft. An 18-in. pulley was keyed on the gear shaft of the winch and a wood-lined brake band made to fit around the pulley to control the speed of the drum. As there was not sufficient cable to wrap around the drum, a V-notch 2½ in. deep was cut around the middle of the drum and the rope placed in it. A post with two small pulleys—one above the other—to serve as idlers was placed

*Mining engineer, 25 Broad St., New York.

about 5 ft. in front of the drum. The idlers prevented the fleet of the cable from pulling it out of the notch. The post was firmly attached to the winch foundation, which was made of heavy timbers firmly set in the ground.

The system of track at the top of the hill and at the middle of the incline is shown in the illustrations. The loaded 1-ton cars from the opencut are hooked to the cable and sent down the incline, the empty one of course coming up. The trip is made in 2 min. The gears of the winch prevent the loaded cars from running away, and the brake is applied only when stopping the car, which is dumped by hand at the bottom.

The notch grips the cable firmly, forming an effective friction clutch. Though adopted in an emergency, I believe this method preferable to the usual one of taking several turns around the drum. After several hundred trips, the V-notch showed no appreciable wear. It would, however, be a simple matter to deepen it in case of necessity.

Tamping in the Treadwell Mines

By E. P. Kennedy*

It was after talking to W. O. Snelling, in June, 1910, that the writer decided to systematically enforce the use of tamping in all drill holes. Mr. Snelling at that time was connected with the Government testing laboratory at Pittsburgh and had had a great deal to do with testing powder to be used for Panama Canal work. His numerous experiments conclusively proved the economy that should result from the use of tamping, especially when using low-grade powders.

One might expect a saving of powder by the use of tamping from a consideration of the composition of the present-day dynamites. The component materials of the various grades of dynamites (40%, 60%, 70%, etc.) all form explosive compounds and all produce about the same energy, the difference being that the higher grades have a greater instantaneous, or initial, shock. Formerly, when an inert substance such as infusorial earth was used in making dynamite, the amount of energy produced by the various grades was directly proportional to the nitroglycerin content. To get the greatest amount of the explosive energy expended in useful work is the function of tamping, and its importance is clearly exemplified by the harmless burning of a stick of dynamite in the open air and the destructive action of the same stick if confined ever so little.

Some experimenting was done at the Treadwell in making up tamping. Core machines such as are used for foundry work were tried, but soon discarded as being too slow. The material used was thoroughly dry sand (tailings) mixed with a small amount of crude oil, and this was filled into blue-colored paper cartridges by the use of a brass tube. The paper for the cartridges was designated as blue granite wrapper and was purchased cut to size 8x10 or 10x12 in. bias cut, costing six cents a pound by the ton, or less than one mill per cartridge. The sheets are the same size and shape as the containers for 1¼-in. powder. These cartridges of tamping were made up by the powder men in their spare time, packed in powder boxes, sent into the mines each day with the powder and distributed to the various magazines, from which they were issued with the powder to the machine men.

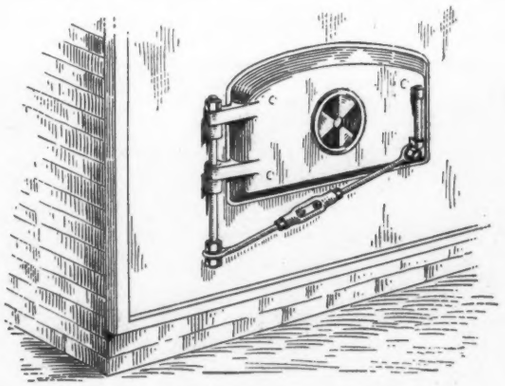
By introducing the tamping in this way, there was no extra work required of the machine men. This is an essential point to be considered and often ignored when something new is to be introduced which will effect a saving for the employer with no apparent benefit to the employee. When tamping was first introduced, the bosses cut down the amount of powder given out, by one stick per hole, which was made up by issuing tamping differing in appearance from the powder by the blue-colored wrapper. The result was very satisfactory except in a few instances at first, when the tamping was placed by the machine helper in the bottom of the hole.

The cost of the tamping was negligible, while the direct saving in powder was considerable. The proper use of tamping practically eliminated burnt-out holes, and its use proved a step in the direction of safety. About 175,000 holes are drilled per year in the Treadwell mines, so that a saving of one stick of powder per hole means the saving of about 1,750 boxes of powder per year.

*Mining engineer, 720 Foxcroft Building, San Francisco, Calif.

Old Fire-Doors Made Usable*

The suggestion in the issue of Feb. 5, 1916, page 261, relative to making old fire-doors usable is interesting, but the method described has the disadvantage of rapid wear at the rod connection with the angle iron, and there is also more or less heat at a location above the door and a subsequent warping of the rod and the angle iron, requiring frequent straightening. The repairman in a large industrial plant having a number of boilers to care for uses the method shown in the illustration.



DOOR SUPPORTED FROM BELOW

The door is first blocked in position, and with a ratchet and extension drill (an ordinary drill welded to a long shank) the holes in the hinges are reamed out to about 1 in. diameter and a new hinge pin extending about 9 in. below the bottom hinge is used. A turnbuckle rod is fastened to the lower end of this pin by two nuts.

This makes a substantial arrangement, obviating wear at the rod because it forms a part of the swinging hinge pin and door; there is no warping from heat, and the turnbuckle adjustment takes care of the sag. It is also a neat-appearing job and will give perfect satisfaction if the parts are proportioned to the weight of the door.

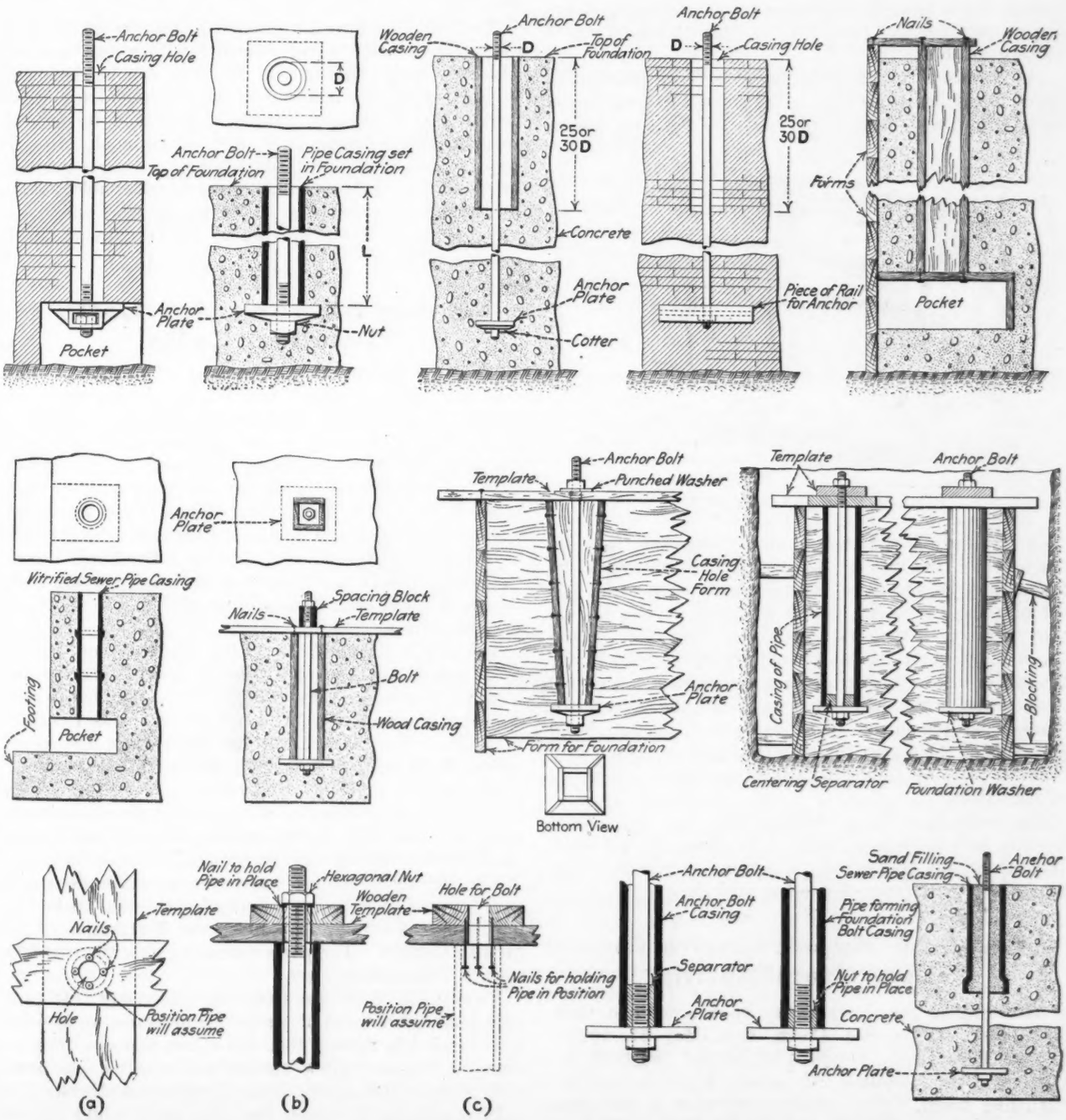
*By Robert Fullerton, Perth Amboy, N. J., in "Power," Mar. 21, 1916.

Foundation-Bolt Casings for Machinery

A casing for a machine-foundation anchor bolt is a tube, either of metal or wood, located concentrically around the anchor bolt. Its principal function is to permit a lateral movement in all directions of the top of the foundation bolt. This is frequently necessary because of inaccuracies in locating the bolts; also, holes in machine bedplates are often cored and inaccuracies in their locations may be expected. If the bolt or the hole is out of its proper place, the bolt can thus be sprung over readily so as to correct the inaccuracy; whereas if it were solid in the foundation, that is, if no casing were provided, it would be necessary to enlarge the hole in the bedplate to compensate for the error. Obviously, it is an expensive and time-wasting procedure to enlarge holes in bedplates.

The second function of a casing is to permit the removal of the anchor bolt. Where this is desirable, it is necessary to provide a pocket under the anchor plate for the reception of the nut on the lower end of the bolt.

When to use and when not to use casings admits of no general answer. The accompanying illustrations show various types of casings, described in *Power*[1], which will various types of casings, described by Bruce Page in *Power* of Jan. 4, 1916, which will be of service to engineers in mining communities. This problem is not as simple as it at first seems and often causes a lot of trouble because of lack of preparation. One of the casings shown will be available for almost any case.



DIFFERENT TYPES OF CASINGS AND TEMPLETS FOR FOUNDATION ANCHOR BOLTS

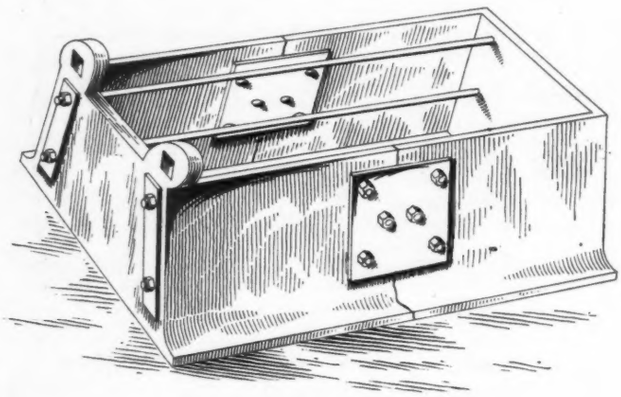
Details of Milling and Smelting

Repairing a Roll Frame

By Charles Labbe*

In a dry-crushing plant where the product from the fine-crushing rolls had to be finer than was practicable with high capacity, the attendants tightened the springs until the rolls were practically rigid. One day a drill shank went in with the ore and the frame of the roll was broken in two pieces. The frame had stood a heavy strain, for no part was less than 1¼ in. thick and a very good casting at that.

As in most mills where the motto is "keep running," a quick repair had to be made. We bored a 1¼-in. hole at each corner, and through the holes we put four 1⅛-in.



REPAIR ON ROLL FRAME

rods with threads at both ends and a yoke plate, 4x½ in., the height of the frame. By tightening the four rods the frame came back to place, but on account of the work this set of rolls had to do, we did not think it safe for the rods to carry all the strain, so we cut four pieces 12x24 in. of ¼-in. sheet iron and bored six ¾-in. holes in the plates (in one setting by putting the 4 plates one on top of the other in the drill press) and bored the same in the frame. We placed one plate inside and one outside on each side of the frame, covering the break in it, and held them in place by tight-fitting bolts, as it was not handy to use rivets.

The rolls have been running that way for several months, and there is no sign of anything getting loose. It goes without saying that the springs were loosened to prevent the recurrence of another mishap.

Calcium Hypochlorite for Water Sterilization

According to recent researches by Vincent and Gaillard (abstr. *Journ.* Soc. Chem. Ind., May 31, 1915), calcium hypochlorite possesses undoubted practical advantages over solutions of alkali hypochlorites for sterilizing water. It is conveniently used in the form of compressed tablets, each containing 0.015 gram of calcium hypochlorite (= 3.5 mg. available chlorine) and 0.08 gram of sodium chloride, the latter being added to promote the diffusion of the active chlorine into the water. Each tablet is sufficient for 1 liter and is added to the water without previous crushing. After 20 min. practically the whole of the chlorine has diffused into the water and merely a skeleton of calcium carbonate remains.

The tablets keep well, a diminution of only 0.0003 gram of active chlorine being observed within two months. Drinking water sterilized in this way can be consumed 20 min. after the addition of the tablet. Its mineral composition is thereby scarcely altered, and its taste is inappreciable. Ammoniacal and albuminoid nitrogen were found to diminish by one-half to three-quarters after the sterilization with a hypochlorite tablet, while all pathogenic organisms, including *Bacillus coli,* were killed in 10 to 12 min., even in the pressure of much organic nitrogen.

Testing Blankets for Callow Flotation Cells

A test of various blankets for use in Callow flotation cells was made by Laist and Wiggin during their experiments on flotation at Anaconda, a paper descriptive of which will be read at the Arizona meeting of the American Institute of Mining Engineers in September, 1916. Four blankets for Callow cells were received from Lane & Co., New York City. These were numbered 1,038, 1,039, 1,057 and 1,058. In each case the blankets have a better distribution of air after a few hours' operation, due probably to a readjustment in the weaving after the blanket has been thoroughly wetted. The results of the test were as follows:

The single thickness No. 1,058 was used on Callow cells treating sand tailings. The air distribution was uneven and if enough air was turned into the chamber to keep the sand moving on the blanket there was violent boiling at points. The blanket was not satisfactory for coarse (60-mesh) feed, but might work fairly well on slimes.

The double thickness No. 1,058 was used on slimes feed. The air distribution was good and the results were practically the same as the regular Callow blanket supplied by the General Engineering Co., of Salt Lake.

The No. 1,039 blanket was tested on slimes feed and gave an even distribution for all air pressures up to 5½ lb. Blanket No. 1,057 gave an uneven distribution of air for all pressures. The pores seemed to close up unevenly when the blanket was wet.

Blanket No. 1,038 was tested on slimes feed. It gave very good distribution of air for all pressures up to 4 lb. This blanket is thinner than the others and also thinner than the regular Callow blanket and requires less pressure to deliver the same volume of air as the others.

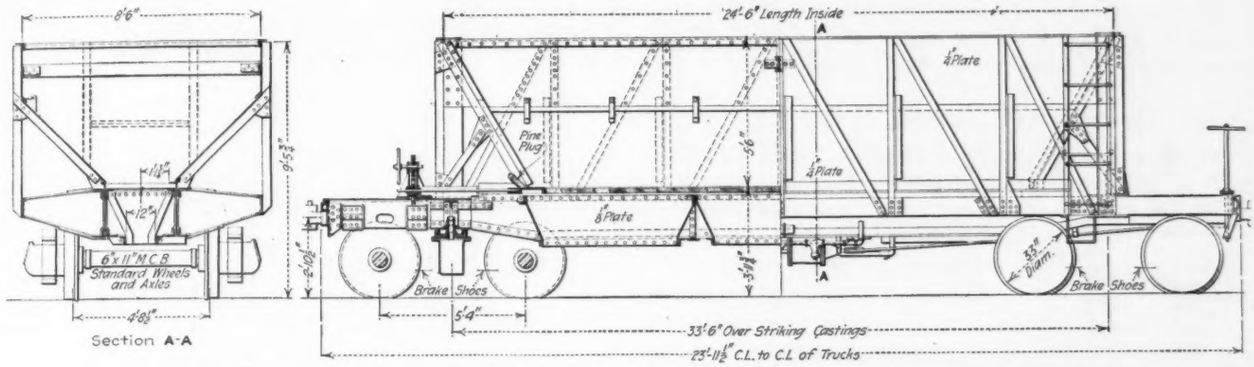
In conclusion it is seen that No. 1,057 would not be satisfactory for our purposes; No. 1,058, single, would

*Nelson, Nev.

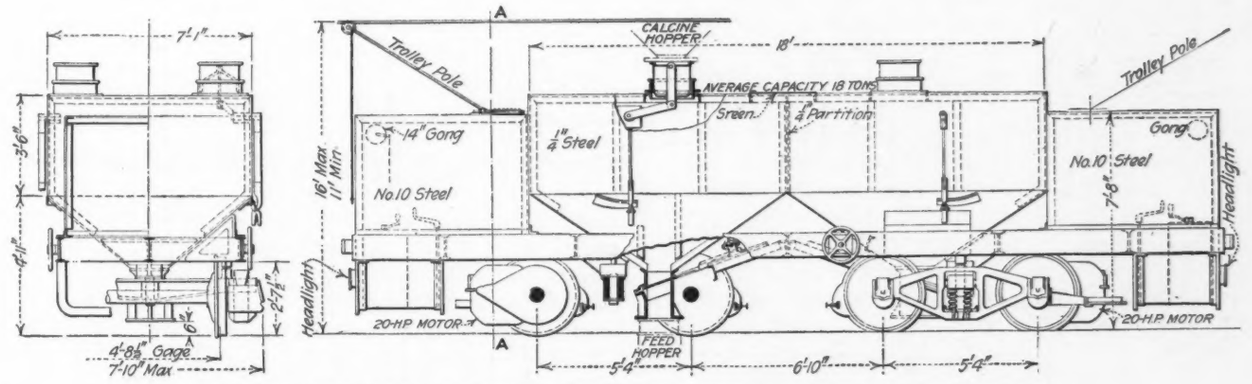
not be satisfactory, except possibly on slimes feed; No. 1,058, double, would be satisfactory for either slimes or sands, but would probably cost too much; No. 1,038 would be entirely satisfactory for slimes and would probably be all right on sands.

Concentrate and Calcine Cars at Miami Smeltery

The concentrates treated at the new works[1] of the International Smelting Co., at Miami, Ariz., are produced largely by the flotation process and consequently are very fine. Special cars were built for transporting the wet concentrates and for handling the calcines—really dried concentrates, as no roasting is permitted at this plant on account of additional sulphur being required for suitable matte formation.



CAR FOR TRANSPORTING CONCENTRATES TO THE INTERNATIONAL SMELTERY AT MIAMI, ARIZ.



CALCINE CAR USED AT INTERNATIONAL WORKS: CAPACITY ABOUT 18 TONS

General drawings of the cars are shown in the accompanying illustrations. The cars for handling the wet concentrates have a capacity of 60 tons and are hopper-shaped throughout their entire length. The body is of ¼-in. steel. The opening at the bottom is 2 ft. 3 in. wide and is covered with creosoted and matched cross-boards. Before the car is loaded these boards are pressed tightly together by means of a handwheel and screw, their alignment being secured by steel angle guides on each side. In these cars are transported the concentrates made at the Inspiration and Miami mills. In unloading at the smelting works, the wooden plug shown at one end of the car is drawn out by means of a chain block, leaving a hole in the concentrates through which unloading is started. The concentrates are raked down the slope and fall through the slot in the car bottom, the cross-boards being removed one after another as required.

The "calcines," or dried concentrates, from five Wedge furnaces are taken to the reverberatory charge hoppers in steel cars, shown in the lower illustration. These larries have a capacity of about 18 tons. In order to avoid the loss of the fine, rich material by being blown away, the bodies are entirely inclosed and are divided at the middle by a partition. Four receiving chutes of special design are provided to prevent loss by dusting; a cast-steel collar, 8 in. deep with a hole 16 in. in diameter, forms the chute opening in the car top; within this collar the steel chute works. When the car is traveling, the chute is in the lowered position, but when the car is spotted under the dust hoppers, the chute is raised by a lever until it fits against the wide bottom flange of the hopper gate. These hopper gates have the same spacing as the chutes carried by the car, so that all four gates may be operated at one time. Arrangement is made for allowing the air in the car to escape at the top through a screened vent. When the car is spotted over the reverberatory feed hoppers, similar chutes are raised up against the discharge gates, and while the car is emptying, the air is allowed to escape from the bins through pipes into the furnace.

[1] "International Smeltery at Miami," R. W. Kerns, "Eng. and Min. Journ.," Mar. 4, 1916.

Elimination of the Personal Equation in Titrating appears to have been accomplished by Henry Ziegel (American Electrochemical Society's October, 1914, meeting). The stop cock of the burette is opened electrically by throwing a switch, and is closed by an apparatus actuated by the change in potential of the solution as the end point is reached.

Mining & Metallurgical Machinery

Tirrill Equalizing Gas Machine

The Tirrill machine for making gas from gasoline seems to have a field of usefulness in detached laboratories in the mining regions. The apparatus consists of three parts: An air pump operated by a weight or waterwheel, which contains only air and water and can be placed next to the furnace or stoves run by the gas, and consequently can be watched by the furnace operator; a generator and carburetor, which are buried in the ground 30 ft. from the building; and a gas mixer, which is also buried in the ground. The generator being wholly and absolutely buried in the earth, requires no vault of any kind, and needs refilling but once or twice a year. No heat or fire is required to generate the gas.

The weight can be wound up while the machine is running without affecting the gas supply, and the entire installation is approved by the National Board of Fire Underwriters.

The machine has been adopted by the Nevada Consolidated Copper Co., in Nevada, the Anaconda Copper Mining Co., in Montana, the Winona Copper Co., in Michigan, and a large number of iron and steel works situated in widely separated parts of the country.

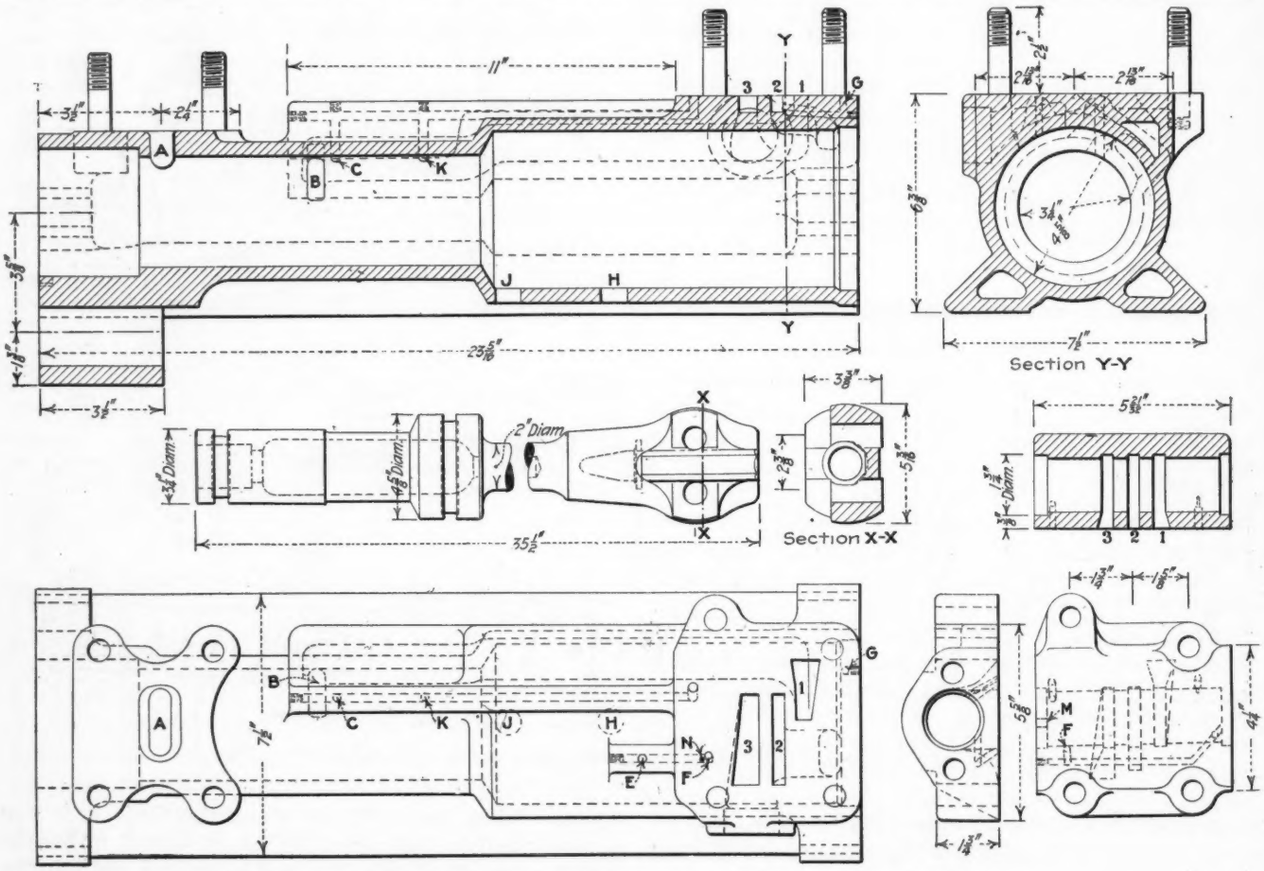
The New Konomax Drill

By E. M. Weston*

The Konomax drill in its present form has not been introduced into America. A number are working on the Bantjes, Consolidated Main Reef, Meyer & Charlton, State Mines and other properties on the Witwatersrand.

The air consumption is slightly more than half that of a 3¼-in. standard drill. They drill rapidly and do equal or greater work than standard drills if they are supplied with a pressure of over 70 lb. at the drill itself. If, however, the pressure falls below that, the drill gives trouble on the return stroke. It also requires more oil than a standard drill and for these reasons and because the Rand miner has an inveterate prejudice against anything novel, the drill is not a favorite among miners. In the newer models arrangement is being made to strengthen the return stroke, sacrificing about 10% air consumption.

Where miners are intelligent and the air pressure is really high, it will easily do work equal to or better than any other drill at a large saving of air cost. The drill has to be maintained in very good order, and a special reamer is employed for reboring the cylinder.



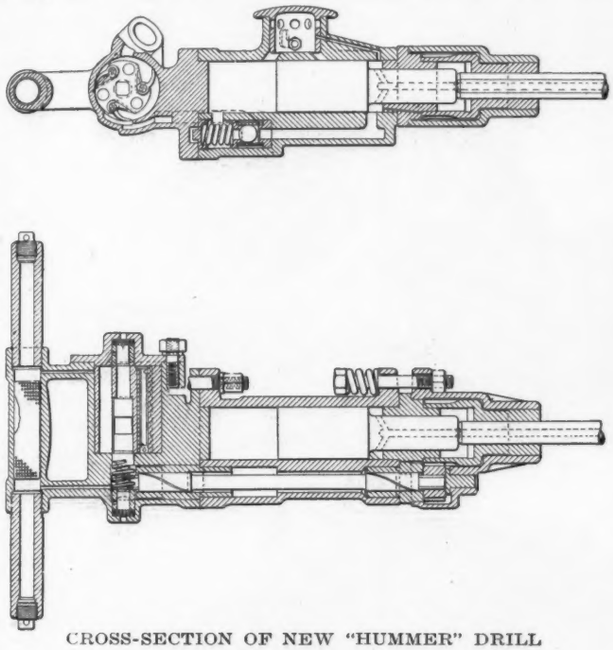
DRAWINGS SHOWING THE CONSTRUCTION OF THE NEW KONOMAX DRILL

*Mining engineer, Randfontein, South Africa.

Self-Rotating Hammer Drill

A departure in hammer-drill construction is embodied in a new line of self-rotating hammer drills known as the "Hummer" drills, manufactured by the Chicago Pneumatic Tool Co., 1036 Fisher Building, Chicago.

The chuck at the front end of the "Hummer" drill is rotated by two simple and strong gears operated by a shaft which is driven by worm gearing from the rotation motor at the upper end of the drill. The rotation motor is a simple form of the rotary type, and the compressed air exhausted from it, instead of being led to the atmosphere, is discharged into the valve



CROSS-SECTION OF NEW "HUMMER" DRILL

chamber of the hammer cylinder and operates the hammer piston by means of a ball-valve action.

The general design is sturdy, well-balanced and compact throughout. By placing the rotation motor at the upper end, it is farthest removed from the strains and shocks of the hammer blows at the front end of the drill, and the distribution of the parts is such as to permit each part being made simple and strong and well-calculated to stand up under the severe conditions to which the rock drill is ordinarily subjected.

The rotation of the drill steel is effected by the motor at the upper end of the drill, in the handle part, and is entirely independent of the hammer piston. The compressed air to operate the drill first enters the rotation motor, causing the rotor of the motor to revolve at a high speed. The rotor shaft is provided with a worm thread that meshes with a worm gear on the outer end of the shaft that transmits the rotary movements to the pinion and gear at the lower end of the drill for turning the drill chuck. The rotation mechanism throughout is continuous in one direction and does not have any ratchet or pawl parts. The high speed of the rotation motor and the large ratio of gear reduction between the motor and the drill chuck give a strong rotation pull on the drill steel. The parts are few, simple, strong and accessible and cannot be incorrectly assembled.

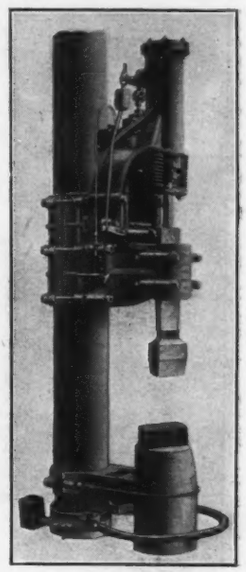
A distinctive feature of the "Hummer" drill is the valve that governs the reciprocation of the hammer piston. It consists of a standard commercial hardened steel ball—such as is used ordinarily for ball bearings. The ball is ¾ in. in diameter and weighs a trifle over an ounce. The travel between its seats in the valve chest is only ⅛ in. It is practically indestructible and ideally simple compared with other rock-drill valve mechanisms.

The hammer piston has no connection with any other part of the drill and is perfectly free in its movements, in both directions, in the cylinder. It is a simple part without any holes or chamber or spiral flutes to weaken it—just a plain piston, structurally of great strength, as a hammer piston should be—and the freedom of its action gives both high velocity and a hard blow.

The "Hummer" hammer drills are made in three sizes: One weighs 40 lb. and has capacity for boring a ⅞-in. hole 6 ft. deep; one weighs 55 lb. and has capacity for boring a 1-in. hole 8 ft. deep; one weighs 65 lb. and has capacity for boring a 1⅛-in. hole 12 ft. deep.

Q M S Post Hammer

The Q M S Co. has just placed upon the market its improved type of post hammer, an illustration of which is herewith shown. The extremely high price of tool steel makes this hammer a valuable adjunct to any machine shop. Short pieces of tool steel, which were formerly scrapped, can be drawn down and used for small lathe tools and in tool holders. The hammer is particularly adapted to all classes of light forging and can be easily handled by a blacksmith, doing away with the necessity of a helper. Thus it will pay for itself in a short time. The machine can be operated by steam or compressed air. A patented valve movement insures perfect control. If the treadle is brought down to the limit, the ram will give a hard, full blow, the same as a drop hammer; or the treadle can be pressed down part way, when the ram will give repeated hard or light blows as may be required. The change from one kind of blow to another is made instantly and smoothly. It is for sale by the Vulcan Engineering Sales Co., 2059 Elston Ave., Chicago, Ill.



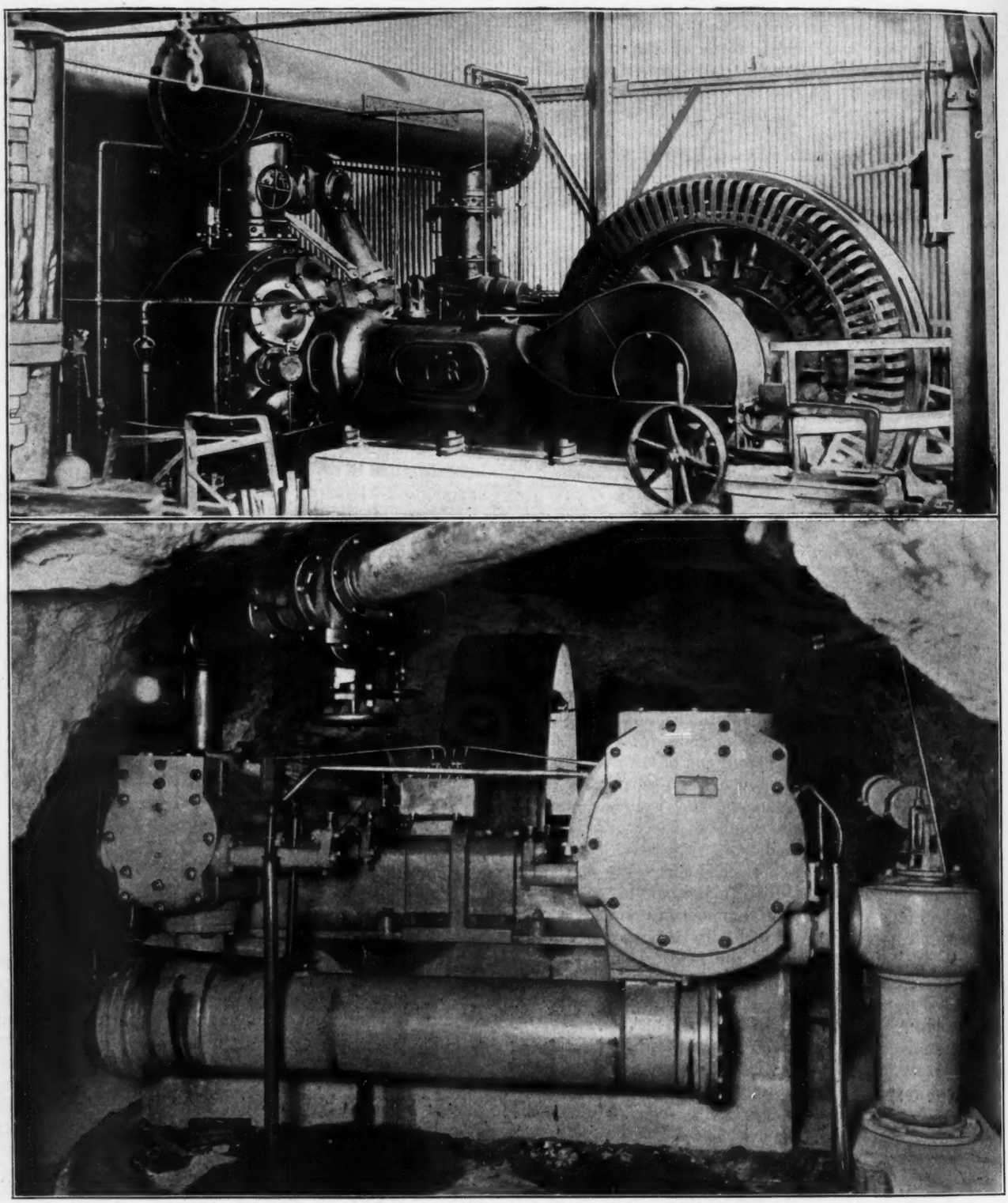
Q M S POST HAMMER

Slide Rule and Flow Computer

A new slide rule is being offered that can be used for all ordinary computations and offers not only a direct solution of all problems involving the flow of liquids, but determines the size of pipe necessary for all different conditions.

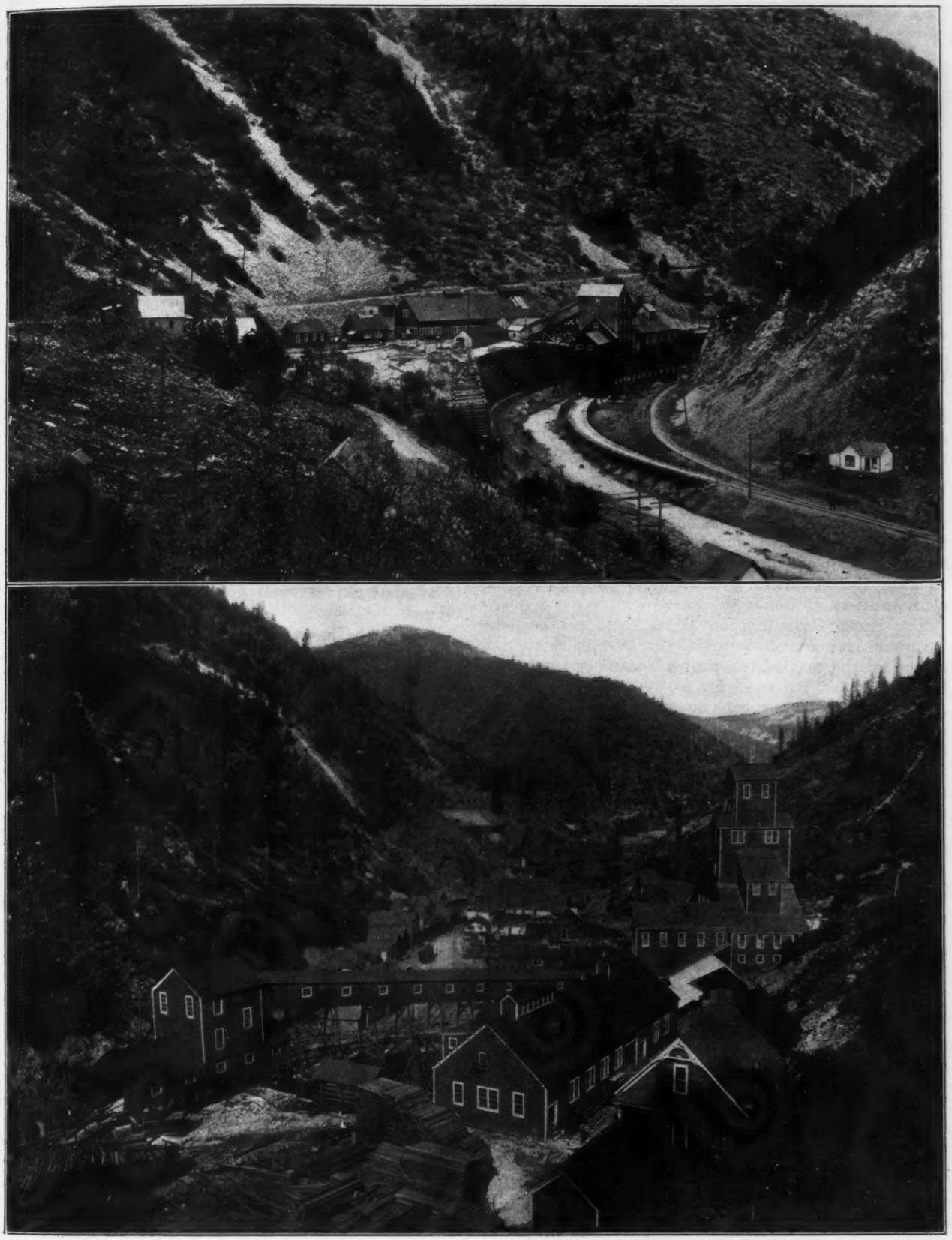
The operation of the instrument is simple. Each quantity involved in the figuring of problems dealing with flow of liquids through pipes is assigned to a separate scale on the face of the rule. The rule is made of celluloid and is permanently attached to a leather case. Directions for the operation are printed on the inside of the cover. It is marketed by Gordon M. Proudfoot, Peoples Gas Building, Chicago, Ill.

Photographs from the Field



TWO RECENT COMPRESSOR INSTALLATIONS THAT ARE NOTEWORTHY

The upper view shows a two-stage Ingersoll-Rogler, 2,380 cu.ft. piston displacement, installed by the Cresson Consolidated Gold Mining Co., Cripple Creek, Colo. The lower view is of an Imperial machine installed 1,200 ft. underground at the Humboldt mine, Ouray, Colo., the object being to make the machine safe from the snow slides common in that district



TWO MINES OF THE CŒUR D'ALENE DISTRICT OF NORTHERN IDAHO

The upper view is of the Standard mine of the Federal Mining and Smelting Co., and the lower of the Hecla mine and surface plant, near Burke, Idaho. The Cœur d'Alene district is at present of particular interest to the metallurgical fraternity because of the phenomenal rise of the price of lead and zinc, metals largely produced in that territory; also because of the almost universal application of oil flotation, which has made a large increase in the profits of many of the companies

Correspondence and Discussion

The Mining-Law Revision

I see by the telegraphic report that the seemingly impossible has happened—the murdering of an infant in the Committee on Mines of the House of Representatives, apparently condemned without a hearing. The governmental appointment of a commission for the revision of the mining laws was such a healthy baby, too—clean-cut, well-balanced; there were to be no ulcers on this baby when it grew to manhood. Efficiency, safety, economy, equity and justice to all were stamped on every part of the foundation material of its make-up.

It was the product of the cleanest and most comprehensive effort for the last 30 years by the greatest students and authorities of the mining world, as well as by the greater number in the game—the men who do things in the industry in a humbler way. It represented to all intents and purposes the unanimous request of the people engaged in a wealth-producing industry practically equal to the great agricultural industry, that the laws pertaining to it be made conformable to existing conditions resulting from the rapid pace of progress being made in all industries.

The House Committee on Mines could not possibly have been ignorant of the practically unanimous request of the mining men of the United States—not only the big fellows, but the small fry as well—to simplify, define and cover a larger scope by a new, not doctored, set of mining laws applying to and conforming to present advanced mining methods.

We cry shame upon the members of the House committee who, through either garrulous antipathy to mining in general or selfish motives, authorized the murder of this clean-cut, healthy baby, which, if not subsequently inoculated with disease prevalent in the past, would have grown to manhood and become one of the greatest factors in the economical and efficient development of one of the greatest industries of our country.

But the thing is done. However, it cannot be final, although undoubtedly delayed, for ultimately we will secure the remedy.

And right here is where I would suggest as a means of hastening the remedy the application of a bit of medicine—not pleasant to the taste, but sure to cure—by the mining men of the United States to the adverse members of the House committee, to which, in my opinion, the latter have laid themselves open.

When we meet with an obstruction in a trail that we can't get over or around, we remove it. It is simply a question of method.

The method I would suggest in this instance is, that a fund—pretty good size—be subscribed to by the mining men of the country for the purpose of defeating these adverse members for reëlection. The means to be absolutely fair—by employing the best orators obtainable and educating their constituents to the fact that these men are not competent to represent any section of the country, because of lack of balance to concede to the just and necessary demand of one of the greatest industries in the United States.

If personal interest was involved in the rejection of the bill, so much the worse. If merely antipathy or garrulousness, the charge of incompetence still holds good. These men have handed the mining men a lemon, and I feel that the mining men are duty bound to hand them a persimmon. The *Engineering and Mining Journal* is in best position to start the ball rolling.

CHARLES ESTMERE,
U. S. Deputy Mineral Surveyor.

Flat, Alaska, Jan. 29, 1916.

Fineness of Ore Crushing for Assaying

The point at issue with E. J. Hall is whether the decomposition, $2NaHCO_3 = Na_2CO_3 + H_2CO_3$, "is to all intents and purposes complete before any fusion takes place" in an ore-assay fusion. My letter asking for data was clearly limited to this. It is a condition; time, position, association, as well as temperature, must be considered.

With all he has written, Hall has not cited a single fact to show that the inside of an ore-assay charge is maintained at a sufficient temperature for a sufficient time for the practically complete decomposition of the $NaHCO_3$ before the outside fuses. Apparently, he cannot. An unsupported assumption is a poor foundation for starting a comparison of the use of the two carbonates.

The facts remain that a high temperature is required for the rapid decomposition of the $NaHCO_3$ and that the outside of the ore-assay charge fuses and incloses the inside before this temperature is reached by the inside.

FREDERIC P. DEWEY.

Washington, D. C., Mar. 6, 1916.

Use of Lime in Assay Fluxes

There has been considerable discussion of the relative merits of sodium carbonate and sodium bicarbonate. It seems to me that although stirring of the charge by carbon-dioxide gas is desirable, still the carbon dioxide liberated from the bicarbonate comes off at altogether too low a temperature to be effective at the time it is needed.

Some of your correspondents have called attention to the probability that only the carbon dioxide from the reducing agent and litharge is effective in stirring. The addition of calcium carbonate will produce a stirring at the time it is needed, because the CO_2 is liberated at a high temperature. A small quantity of lime is a welcome addition to charges which do not contain it.

Los Angeles, Calif., Feb. 26, 1916. JOHN HERMAN.

The Vulcan Detinning Co. Reports for the Year 1915 that its total earnings were $700,244; expenses, repairs, renewals, etc., $639,293; leaving net earnings of $60,951. Other income was $2,126, making total surplus for the year $63,077. This compares with a deficit of $73,939 for the previous year.

The Pig-Lead Market

Referring to current comments in the press and otherwise, as to the pig-lead sales policy of the American Smelting and Refining Co., we take pleasure in giving the following information:

1. We are producers of pig lead from our own mines to a very considerable extent, and we are therefore desirous of having the price of lead as satisfactory as can be maintained legitimately and have the production of the country consumed without injury to the manufacturers. Our policy is to look to the general good over a considerable space of time, rather than to operate along speculative or temporary lines.

2. Aside from the amount of lead produced by our own mines, all of the lead that we produce is received from mines with which we have contracts requiring the miner to ship his entire production to our company, and for which the miner is paid daily in accordance with our quoted price. Therefore, the lead that we receive in any month is paid for by us to the miner at our average quoted price for the month.

3. Since the smelting and refining profit per ton of lead is very small, it is necessary that we should not jeopardize this profit by risks in the pig-lead market. Therefore the policy of the company is to sell as large a proportion as possible of its product at the average quotation of the company. As a matter of fact, more than 75% of all of our lead is being sold at the present time upon average-price contracts. Therefore the amount of lead which the company has for sale, outside of its contracts, is comparatively small.

4. The policy of the company, in the selling of this smaller amount, is to give preference at all times to its regular customers. Owing to extraordinary demands, not only domestic but for exportation, there has been recently a shortage of lead. We have thought it advisable, therefore, to decline to sell or to quote to anyone except our regular domestic customers for their normal consumption.

5. We are making our quoted price (at which more than 75% of our lead is being sold every day on average-price contracts, and which we are quoting for the remainder of our production) at what we believe is a fair equilibrium between supply and demand, confined to the domestic consumption. If the price of pig lead continues to advance, it will result in decreasing the consumption and curtailing the lead industries of the United States. It is not the opinion of this company that this would be advisable, even if the extraordinary demands of other sections of the world are such as to warrant their paying prices for war material that are not warranted by domestic consumption.

We believe that the public will be interested in this declaration of principles, which are governing and have governed the pig-lead sales policy of this company.

EDWARD BRUSH.

Vice-President, American Smelting and Refining Co.

New York, Mar. 21, 1916.

[What Mr. Brush has stated is borne out by the reports in our weekly record of the market during the last month, wherein it has been chronicled that while premiums were being realized on some lead, large quantities were being supplied at the quotation of the principal producer, which was not a merely nominal quotation.

The other important producers of lead dispose of their product to a large extent upon contracts based on quotational averages in substantially the same way as is done by the American Smelting and Refining Co. They also, during the recent period of extraordinary demand for export, have sought to protect their regular customers and domestic consumers generally in filling their requirements in excess of the contractual, although they have not all been so consistent in that policy of late.

To those who have not been conversant with the conditions, the recent course of the American Smelting and Refining Co. in the lead market, which has now been explained by Mr. Brush, has been mystifying. Some remarks on this subject that we made last week were either misunderstood or misrepresented. We referred ironically to suggestions of manipulation in the lead market that had been made in some of the daily papers, but we made no such charge and did not intend to imply anything of that sort, though we were caused to appear to do so by the omission of what followed the first paragraph of our article by certain papers that quoted us.—Editor.]

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALLOYS—Improvements in and Relating to the Production of Metals or Metal Alloys. E. Kardos, Ilford, Essex, Eng. (Brit. No. 22,946 of 1914.)

CALCINING—Process and Apparatus for Calcining Chemical Products. Henry Howard, Brookline, Mass. (U. S. No. 1,173,428; Feb. 29, 1916.)

CALCINING FURNACE. George Moore, Joplin, Mo. (U. S. No. 1,174,086; Mar. 7, 1916.)

CRUSHING—Lining Plate for Ball-Mills. Alexander V. Jensen, Devils Slide, Utah, assignor to American Manganese Steel Co., Augusta, Me. (U. S. No. 1,174,160; Mar. 7, 1916.)

DREDGE SLUICE JIG. Donald Steel, Palo Alto, Calif. (U. S. No. 1,173,465; Feb. 29, 1916.)

DRILLING—Steel-Extracting Device for Stoping Machines. Carl Hamilton, Lowell, Ariz., assignor of one-half to J. H. Cunningham, Lowell, Ariz. (U. S. No. 1,174,858; Mar. 7, 1916.)

EXPLOSIONS—A Method and Apparatus for Localizing Mine Explosions and Fires. J. S. Grasty and W. S. Rodman, Albemarle, Va. (Brit. No. 12,238 or 1915.)

FELDSPAR—Method of Producting Certain Commercial Products from Potash Feldspar. Edward L. Anderson, Pittsburgh, Penn., assignor to John S. Snyder, Pittsburgh, Penn. (U. S. No. 1,174,795; Mar. 7, 1916.)

FLOTATION MACHINE. Frederick B. Kollberg and Max Kraut, Bisbee, Ariz. (U. S. No. 1,174,797; Mar. 7, 1916.)

FUEL—Briquet and Method of Producing the Same. Louis J. Curtman, New York, N. Y. (U. S. No. 1,173,779; Feb. 29, 1916.)

FUEL—Device for Feeding Powdered Fuel. John L. Boardman, Billings, Mont. (U. S. No. 1,173,995; Feb. 29, 1916.)

FUEL—Method for Burning Fuel. Henry M. Chance, Philadelphia, Penn. (U. S. No. 1,173,708; Feb. 29, 1916.)

LAMP—Acetylene Lamp. Frederic E. Baldwin, New York. N. Y. (U. S. Nos. 1,174,036, 1,174,037 and 1,174,112; Mar. 7, 1916.)

LAMP—Miner's Gas-Burner Lamp. Frederic E. Baldwin, New York, N. Y. (U. S. No. 1,174,035; Mar. 7, 1916.)

LAMPS—Improvements in Miner's Safety Lamps. J. Davis and Son, Derby, Eng. (Brit. No. 3,041 of 1915.)

ORE TREATMENT—Treatment of Ores. Otto Carl Rudolph, Aldwych, London, England, assignor to Otto Stalmann, Salt Lake City, Utah. (U. S. No. 1,171,255; Feb. 8, 1916.)

ROASTING—Ore-Roasting Apparatus. Harrison T. Benson, Denver, Colo., assignor of one-half to Winfield S. Barnes, Philadelphia, Penn. (U. S. No. 1,171,583; Feb. 15, 1916.)

ROASTING—Ore-Roasting Furnace. William H. Motter, Denver, Colo., assignor to Mary A. Motter. (U. S. No. 1,172,479; Feb. 22, 1916.)

TIN—A Process for Extracting Tin from Tin-Plate Waste. Chemische Fabrik von der Linde and Gustav von der Linde. Crefeld, Germany. (Brit. No. 11,071 of 1914.)

TUNNELING MACHINE. John W. Cook, Miami, Fla., assignor of one-third to George A. Waldeck, Miami, Fla. (U. S. No. 1,172,876; Feb. 22, 1916.)

ZINC—Improvements in or Relating to the Extraction of Zinc Compounds from Zinc Ores or Products. H. T. Durant and Metals Extraction Corp., Ltd., London, Eng. (Brit. No. 21,737.)

United States Steel Corporation

The report of the United States Steel Corporation for the calendar year 1915 covers such an extended property and so many different plants that a summary within reasonable limits is necessarily a closely condensed one. It is of much importance, as it covers between 45 and 50% of the total iron and steel trade of the country and indicates pretty clearly the general course of that trade.

The general balance sheet at the close of the year, condensed as closely as possible, is as follows:

CONDENSED BALANCE SHEET

Common stock	$508,302,500
Preferred stock	360,281,100
Stock subsidiary companies not owned	587,742
Bonded debt, U. S. Steel Corp.	436,046,000
Bonded debt subsidiary companies	180,386,706
Notes, mortgages, etc., subsidiary companies	27,031,927
Current liabilities	64,834,330
Reserve funds	36,046,227
Appropriated surplus	55,000,000
Undivided surplus	180,025,329
Total liabilities	$1,848,541,861
Property accounts, less depreciation fund	$1,443,300,766
Mining royalties advanced	43,865,195
Deferred charges, etc	4,866,408
Sinking fund assets	19,554,596
Current assets, material, cash, etc	336,954,896
Total assets	$1,848,541,861

Of the current assets inventories of materials and products on hand represent $161,113,900; accounts receivable, $66,308,294; cash on hand, $94,083,805, being current working capital.

The net decrease of bonded debt in 1915 was $10,669,566. The amount paid from earnings for depreciation, replacements, exhaustion of minerals and similar purposes was $72,957,988. The net amount paid for extensions of plant and new construction was $15,337,432. The report gives a complete statement of improvements and additions made during the year.

Income for the Year

The income account for 1915, summarized and condensed as far as possible, was as follows, amount from gross sales and earnings including the intercompany business:

Gross sales and earnings	$726,683,589
Royalties, interest, etc., etc	6,977,016
Total	$733,660,605
Operating and general expenses	$581,147,437
Subsidiary companies charges	12,263,102
Total	$593,410,539
Net earnings	$140,250,066
Interest, subsidiary companies	$9,854,055
Depreciation and sinking funds	32,428,049
Interest, etc., Steel Corporation bonds	22,899,944
Total charges	$65,182,048
Total surplus	$75,068,018

To this surplus was added a balance of $765,814 for adjustment of accounts, etc., making a total of $75,833,832. Dividends paid were 7% on preferred stock, $25,219,677; and 1¼% on common stock, $6,353,781; a total of $31,573,458, leaving $44,260,374 as undivided surplus.

Total shipments of materials, except cement, to domestic customers were 10,982,748 tons; for export, 2,429,739 tons. The total of rolled steel and other finished products, not including sundry byproducts, was 11,681,887 tons. The increase in domestic shipments was 13.1%; in exports, 112.4%. The value of domestic shipments was $391,188,661; of exports, $95,163,393, against $337,444,052 and $42,784,091 respectively, in 1914.

The prices received in 1915, based on the total tonnage of rolled and other finished-steel products shipped, showed, in respect of domestic shipments, an increase of 26c. per ton over the average price per ton received in 1914, but in respect of export shipments the increase was $4.19 per ton, and for both domestic and export the average increase was $1.05 per ton.

The total production of materials of all kinds in 1915 was as follows, compared with the previous year:

TOTAL PRODUCTION IN 1914 AND 1915

Products	1914 Tons	1915 Tons
Iron Ore mined:		
In the Lake Superior Region:		
Mesabi Range	10,894,463	17,209,664
Vermilion Range	1,112,854	1,273,825
Gogebic Range	1,469,601	1,277,419
Menominee Range	874,909	939,304
Marquette Range	496,896	618,108
In the Southern Region:		
Tennessee Coal, Iron and R.R. Co.'s Mines	2,186,258	2,351,356
Total	17,034,981	23,669,676
Limestone quarried	4,676,479	5,795,925
Coal Mined:		
For use in the manufacture of coke	15,890,382	20,800,204
For steam, gas and all other purposes	5,271,911	5,828,278
Total	21,162,293	26,628,482
Coke Manufactured:		
In beehive ovens	7,092,792	9,701,692
In byproduct ovens	4,081,122	4,799,126
Total	11,173,914	14,500,818
Blast-furnace Production:		
Pig iron	9,909,062	13,517,598
Spiegel	25,397	7,175
Ferro-manganese and silicon	117,998	116,735
Total	10,052,457	13,641,508
Steel-Ingot Production:		
Bessemer ingots	4,151,510	5,584,198
Openhearth ingots	7,674,966	10,792,294
Total	11,826,476	16,376,492
Rolled and Other Finished-Steel Products for Sale:		
Steel rails (heavy and light tee and girder)	978,907	1,129,832
Blooms, billets, slabs, sheet and tinplate bars	921,826	1,404,443
Plates	689,241	974,741
Heavy structural shapes	613,739	726,082
Merchant steel, bars, hoops, bands, skelp, etc.	1,423,740	2,118,366
Tubing and pipe	818,435	919,280
Wire rods	164,153	261,036
Wire and products of wire	1,380,376	1,771,945
Sheets (black and galvanized) and tinplates	1,075,419	1,368,178
Finished structural work	521,225	476,896
Angle splice-bars and all other rail joints	129,849	190,758
Spikes, bolts, nuts and rivets	62,133	74,289
Axles	64,662	95,476
Steel car wheels	53,638	77,569
Sundry steel and iron products	117,169	173,748
Total	9,014,512	11,762,639
Spelter	28,031	32,031
Sulphate of iron	30,212	35,377
	Bbl.	Bbl.
Universal portland cement	9,116,000	7,648,658

The improvement in the demand for iron and steel products which became evident before the middle of 1915 continued in increasing volume throughout the remainder of the year, both for the domestic and the export trade. Until the latter part of the year, however, the advances in the prices received for domestic business were moderate, and the average selling prices received for the year were only slightly in excess of those for the preceding year. In the closing months of the year the demand for products for the domestic trade for future delivery exceeded the producing capacity of the country and caused price advances. The demand for products for export was the largest for any year in the history of the Corporation. At Dec. 31, 1915, the unfilled orders of the subsidiary companies for both the domestic and export trade totaled 7,806,228 tons of rolled products.

The total production for the year 1915 of all classes of rolled and other finished-steel products for sale was equal to about 85% of the annual capacity of the mills.

During the last quarter of the year the output equaled the maximum steel-producing capacity. The year's production of cement was about 64% of the capacity.

In addition to the iron and steel plants the Corporation owns 252,956 acres of coal property in Pennsylvania, West Virginia, Ohio and Indiana, with 72 coking plants; 226,820 acres coal lands in Alabama, with seven coking plants. It owns 1,058 miles of railroad equipped with 1,393 locomotives and 52,195 cars. It has nine seagoing steamships; 74 steamers and 22 barges on the Lakes; six steamers and 92 barges on the Ohio River.

The Duluth plant of the Minnesota Steel Co., which has been in course of construction for several years, was partly placed in operation in December, 1915. Blast furnace No. 1 was blown in on Nov. 29, and four of the openhearth steel furnaces went into operation in December, the first steel having been made on Dec. 11. Steel was rolled on the 40-in. blooming mill on Dec. 13 and on the 28-18-in. mill on Dec. 23. It is expected that the remaining six openhearth furnaces and the merchant mills will be ready for operation in April, 1916. The Duluth plant when fully completed will have an annual capacity of 360,000 tons of finished rolled-steel products, which may be increased later.

Employees and Pay Rolls

The average number of employees in the service of all companies during the year 1915, in comparison with the year 1914, was as follows:

Employees of	1914 Number	1915 Number
Manufacturing properties	131,616	140,875
Coal and coke properties	16,155	19,485
Iron-ore properties	11,170	9,668
Transportation properties	17,857	18,240
Miscellaneous properties	2,555	2,858
Total	179,353	191,126
Total salaries and wages paid	$162,379,907	$176,800,864
Average Salary or Wage per Employee per Day:		
All employees, exclusive of general administrative and selling force	$2.88	$2.92
Total employees, including general administrative and selling force	$2.97	$3.01

The lowest average number of employees in any single month in 1915 was 141,461 in January, and the highest average number was 227,051 in December, 1915. The total payroll in January was $10,677,017 and in December $17,801,289.

On Feb. 1, 1916, an advance was made in the wages and salaries of the employees of the subsidiary companies. This increase averaged approximately 10% on the rates previously paid the employees affected. On basis of an annual payroll equal in numbers to that for 1915, these advances in rates will call for an increased disbursement of approximately $14,000,000 per annum, while on basis of an employment equal to the average during 1913, the increased amount will be about $18,000,000 annually.

As of Jan. 1, 1916, there was offered to employees of the United States Steel Corporation and of the subsidiary companies, the privilege of subscribing for shares of common stock of the Corporation, at the price of $85 per share. Subscriptions were received from 24,940 employees for an aggregate of 49,742 shares. The conditions attached to the offer and subscription, aside from the feature of price, were generally similar to those under which stock has been heretofore offered to employees. The usual distribution of special compensation to employees under the plan adopted in 1903 was also made.

During the year the trustees of the United States Steel and Carnegie Pension Fund disbursed in pensions to retired employees the sum of $659,389.42. In 1915 pensions were granted to 697 retiring employees. At Dec. 31, 1915, there were 3,002 names on the pension rolls. The average age at which pensions to the foregoing were granted was 62.84 yr., and the average term of service rendered by pensioners was 28.34 yr.

During the past year, as in preceding years, careful thought and study have been given to conditions under which the employees work and live. The principal work during the year, however, was in extending efforts on lines that had already proved successful.

Although additional expenditures are being made wherever necessary through installation of devices, facilities, etc., to safeguard employees from injuries, special attention is now being directed toward enlisting the employees themselves in the prevention of accidents. At present 4,249 employees are serving on safety committees whose efforts are being expended in this direction.

The amount expended in 1915 by all companies for safety work was $608,644. Serious and fatal accidents in 1915, based on the number of accidents per 100 employees in service, were 5% less than in 1914 and 43.5% less than in 1906. Fatal accidents in 1915 were 15.38% less than in 1914 and 59.27% less than in 1906.

Metal-Mine Accidents in 1914

The annual report[1] of Albert H. Fay on mine accidents is getting to be a classic for the mine operator, who is endeavoring to reduce his accident list and wishes to learn where his operation stands in comparison with the general results in the industry. In Technical Paper 129, Mr. Fay reports upon the metal-mine accidents in the United States during the calendar year 1914. One of the especially interesting features of the present report is a classification and chart of accidents grouped by mining methods.

The fatalities in the metal mines of the United States in 1914 were 559, a rate of 3.54 per 1,000 employed; this is a slight decrease as compared with the previous year. The 1914 rate for all mines and quarries of the United States, in which 1,009,236 men were employed, was 3.16 per 1,000, the quarry record being 2.05 and the coal-mine rate 3.22; the metal mines thus continue to have a higher death-rate than the coal mines on the basis of the actual number employed, but the metal mines worked more days per year; when reduced to a common basis of 300 days, the metal-mine fatalities averaged 3.92 per 1,000 as against 4.67 for the coal mines. Though there are a few increases, most of the metal-mining states show decreases; Montana and Nevada have done particularly good work in accident prevention, showing a continuous reduction in fatality rates during the four years for which comparative statistics have been collected. States exceeding the average rate in 1914 were: Kentucky, 9.05; North Carolina, 8.05; Tennessee, 5.53; Colorado, 5.09; Oklahoma, 5.03; Utah, 4.97; Alabama, 4.78; Idaho, 4.76; Arizona, 4.50; Wisconsin, 4.27; California, 4.20; New York, 3.66; Michigan, 3.63. Of the more important metal-mining states, doing over 1,000,000 days'

[1]Technical Paper 129, "Metal-Mine Accidents in the United States During the Calendar Year 1914," by Albert H. Fay, U. S. Bureau of Mines, Washington, D. C.

work per annum, Minnesota had the best record, 2.43; Alaska, with 2,052,450 days' work, showed a fatality rate of only 2.38, though these records were not directly received as in the case of the states.

The fatality rate in all copper mines was 3.69; in gold and miscellaneous metal mines, 3.70; iron mines, 3.30; lead and zinc mines (Mississippi Valley only), 3.66; miscellaneous mineral mines, 2.92. The only division making a reduction in fatality rate in 1914 was the copper mines, which had a rate of 4.20 in the previous year as against 3.69 during the year under consideration. The copper mines show a higher rate than the other groups for serious and slightly injured employees, but this is to a great extent due to the fact that most of the copper mines are worked by large companies practically all of which have well-organized safety departments. The result is that accurate records are kept. The figures given for the copper and iron groups are regarded as fairly representative of the hazards of the mining industry.

Falls of Rock Most Prolific Source of Fatalities

Falls of roof continue to be the most prolific cause of mine fatalities, constituting 33% of all accidents and over 50% of the fatal underground accidents. Other important sources of fatalities were: Explosives, 8.76%; falling down chutes or winzes, 8.59%; haulage accidents, 5.55%. Shaft fatalities were 17.89% of the total, 6.08% being credited to "falling down shaft" and 7.70% to skip or cage accidents. Openpit fatalities amounted to 10% of the total, and surface-plant or shop accidents to 6.62%.

The important classification of fatalities by mining method is made in this report by Mr. Fay for the first time. In this classification, incomplete statistics were omitted, but the reports used represented about 75% of the metal-mining industry. Surface-plant accidents were eliminated from the tabulations, as there was no reason why the hazard at the surface plants of a room-and-pillar mining operation would be different from a mine where overhand stoping was the principal method. The predominant mining method determined the classification—in most cases representing 80 to 90% of the work at the individual properties. Six principal classifications were adopted, and the fatality rates for the various methods were as follows: Overhand stoping (narrow veins), 4.90 per 1,000; overhand stoping (wide veins), 5.23; room-and-pillar mining, 5.76; caving systems, 5.10; openpit (with steam shovel), 2.50; openpit (without steam shovel), 2.28. The causes of the fatal and less serious accidents by these methods are also delineated.

Tabulations are presented giving related data such as accidents in metallurgical plants, metal-mine accidents in foreign countries and the laws adopted by various states relating to the reporting of accidents.

Much has been done in standardizing reports of accidents, and Mr. Fay has prepared a blank form which will be mailed to any operator sufficiently interested to consider adopting it as a standard form. With the general adoption of this plan a more satisfactory comparison of statistics may be made.

Correction: Bends for Pipe Line Expansion—In the article by W. L. Durand, page 184, issue of Jan. 22, a typographical error appears in the last line in the answer to the example given. The answer should be 70 in., as a use of the chart in solving the problem will indicate.

Joplin Zinc-Ore Production

By Jesse A. Zook

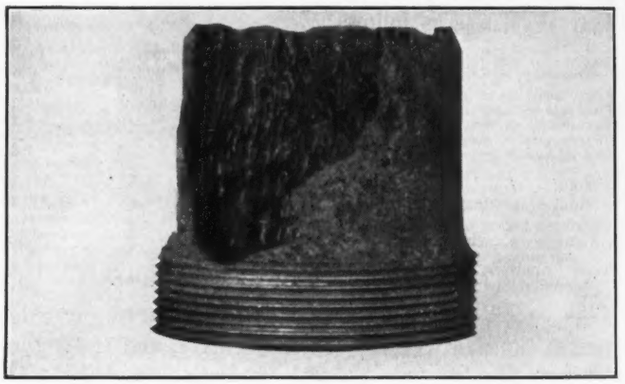
The following is a revised report of the value of shipments for the last two years, of blende, calamine and lead from the mines of southwestern Missouri, southeastern Kansas and northeastern Oklahoma, compared with locally published statistics:

	Blende, Lb.	Calamine, Lb.	Lead, Lb.	Values
	1915			
Missouri	487,410,760	51,014,370	69,104,550	$23,227,620
Kansas	56,889,670	113,000	3,780,870	2,414,260
Oklahoma	53,399,530	230,280	20,339,960	2,755,150
District	597,699,980	51,357,650	93,225,380	$28,397,030
	1914			
Missouri	405,771,260	39,031,880	63,278,710	$10,279,700
Kansas	43,563,080	.....	4,799,710	1,000,715
Oklahoma	61,453,090	.....	16,472,580	1,558,625
District	510,787,430	39,031,880	84,551,000	$12,839,040
Two years....	1,108,487,410	90,389,530	177,776,380	$41,236,070
Two years, local report..	1,057,719,970	75,553,050	173,610,540	$37,961,980
Shortage of local report..	50,767,440	14,836,480	4,165,840	$3,274,090

Erosive Effect of Water

By Walter Swaren*

While overhauling the water-wheel equipment of the Grant Power Co., at its Clipper Gap, Calif., plant, a 4-in. nozzle was removed from one of the Pelton wheels. This wheel was installed 25 years ago and has been in continuous operation since that time. The erosive effect of the water in that period of time is clearly shown in the accompanying illustration.



EFFECT OF WATER EROSION ON A NOZZLE

Tailings-Disposal Conveyors at Chile Exploration Co.

The tailings-disposal conveyor at the Chile Exploration Co. was designed by the company's engineering staff and was built by the Robins Conveying Belt Co. It has a capacity of 10,000 tons per day, instead of being 10,000 ft. long, as stated in connection with the photographs, page 359, in the *Journal* of Feb. 19. The system has been installed in duplicate, so that each disposal conveyor will handle the full capacity of the plant.

These conveyors are about 1,012 ft. center to center and discharge onto cross-shuttle conveyors 512 ft. long, which move at right angles to the main incline conveyors, so that each tailing space would be approximately 1,000 ft. in length. The slope is approximately 22 deg.

*Hayward, Calif.

Editorials

The Situation in Lead

Underlying the present extraordinary situation in lead is clearly a shortage of immediate supply, stocks having probably been exhausted. A change in the method of smelting the ore of the Hercules mine in the Cœur d'Alenes has played a part in this that has not sufficiently been considered. Until recently that ore went to the A. S. & R. Co. The Hercules people lately acquired a smelting plant of their own, which they have just put into operation. The absorption of lead in the stocking of that plant, inevitably very large in the case of any new plant, is a direct subtraction from the market supply. As the new plant gets well into operation, however, the situation is relieved to some extent, although there is always a certain permanent subtraction.

The acuteness of the situation in the market was precipitated by the large demand for lead for export, which began something more than a month ago. There are now some signs of abatement of this. The tenseness of the present situation will probably be relieved greatly if domestic consumers do not become unduly excited and undertake to purchase immediately all the lead that they expect to require for a long time ahead, but rather consider calmly the matter of supplying themselves when the time comes. The whole policy of the principal producers, not only of the A. S. & R. Co., but also of other large independent interests, has been to take care in that way not only of their regular customers but also of domestic consumers generally. A corner and a collapse would not be either to the permanent benefit of the producers or to the best interests of the industry as a whole. The principal producers believe that there will be sufficient lead for the purposes of domestic consumption and that the market will steady itself on an equitable basis if the consumers themselves will be deliberate.

⁂

American Smelting and Refining Company

The seventeenth annual report of the American Smelting and Refining Co., covering the year ended Dec. 31, 1915, is the most interesting report ever issued by that company, not only for the reason that it summarizes the remarkable experiences in an extraordinary year, but also because it communicates fuller data respecting the nature and extent of its business than has ever been done before. The latter is an improvement that we have urged many times. Considering what the company has now done, we do not see that any stockholder has any further cause for complaint on the ground that he is not informed as to what the company is doing.

We shall have to defer a careful analysis of the company's report until a later time. For the present it must suffice to remark that the net income for the year was about $13,000,000, an increase of about $4,000,000 over the previous year. We judge, from a hasty examination of the figures, that the expansion is to be explained chiefly by the larger net earnings from mining properties, which increased by upward of $1,000,000; by the entry of the company on a much larger scale into the highly profitable zinc business; by the larger quantity of copper smelted and refined on toll; and by the appreciation in the value of metals generally. The actual smelting business of the company was a little less than in the previous year, the tons of charge smelted in 1915 having been 4,153,092, compared with 4,171,258 in 1914. However, the total volume of business in 1915 was $224,777,815, against $200,925,625 in 1914.

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Reform of the Mining Laws

The communication from a correspondent in Alaska, printed elsewhere in this issue of the *Journal,* is more pertinent and picturesque than some others, but it is only a sample of what is coming from many quarters, not only to us, but also to the Bureau of Mines, to the offices of the mining societies and to members of Congress. There is reason to believe that members of Congress are beginning to sit up and take notice.

To our Alaskan correspondent and to all the others, and to our readers generally, we convey the message to be of good cheer. The movement toward a great reform has not even been tripped up, much less defeated, by the adverse action of the obtuse members of the Committee on Mines and Mining of the House of Representatives.

That very action resulted in a confirmation of the soundness of the measure that the mining men were advocating. They said it was advisable to have a commission to study and recommend. The luminaries of the House Committee on Mines and Mining said nay. But they were evidently so much impressed by the demand for a reform that they immediately set out to attend to it in their own way, and Doctor Foster introduced a bill that by reason of its absurdity serves as a horrible example, proving the contention of the mining men that the drafting of a proper bill is a matter requiring prolonged study by experts.

The work of the men who inspired the convention in Washington last December is going right along, and the readers of the *Journal* will be kept apprised of it. In the meanwhile let the mining men of the public-land states keep up the agitation. These are the most important things to be done:

1. Let everybody write to his member of Congress, telling him that the mining industry demands this reform. The *one* thing to which a member of Congress pays attention is communications from his constituents. It is particularly important that the mining men who reside in New England, New York and the Eastern States generally write to *their* members, for they are going to vote on the question just like the Rocky Mountain members, and they are in the majority.

2. At the next election let the mining states nominate mining men for Congress. What would Arizona, New Mexico, Nevada, Utah, Montana, Colorado and the rest

be without the mining industry? They ought to be represented by men who are engaged in, and are in sympathy with, the mining industry. Cut out the lawyers, unless they are mining lawyers or unless they are known to be all right, like Mr. Taylor, of Colorado.

An obstacle in the way of the reform of the mining laws is James Wickersham, the delegate from Alaska. It is up to his constituents—the mining men of Alaska—to consider his case.

Copper in Shipbuilding

In former times one of the largest uses of copper was in shipbuilding. This was in the days of wooden ships, which were protected by a sheathing of yellow metal. When wooden ships were displaced by ships of steel, this consumption of copper declined enormously and the effect of it was felt keenly by the copper-producing industry. However, a new use for copper began to develop at about the same time—when the electrical age dawned—and in the course of a few years the consumption for electrical purposes became far greater than it was ever for shipbuilding.

With the expansion of commerce and the building of steel steamships of larger size and more complicated character, a great deal of copper was required in their construction, especially in connection with their machinery and fittings. Since the outbreak of the war and the consequent disturbance of ocean commerce, there has been a remarkable increase in shipbuilding in order to supply necessary cargo-carrying capacity. This prompted the inquiry as to how much copper is required in the construction of a modern steamship. In order to throw some light on this we addressed the following letter to a considerable number of important American shipbuilding companies, all of whom replied, generously communicating the best information that they could:

We are greatly interested in obtaining an idea of the quantity of copper that is used in modern shipbuilding. Would it be possible for you to say that in building a 10,000-ton ship there is required ——— lb. of copper?

We suppose that you would have no great difficulty in thus correlating the copper that you buy and use as such, but we appreciate that you also buy from other concerns many fittings into which copper enters, either in the form of brass or otherwise, whereof you cannot determine the weight of the copper constituent.

Probably the factor that we desire to get at can therefore be stated only approximately, but even an approximate estimate will be helpful to us. We shall be greatly indebted to you if you will assist us in this inquiry in so far as you can.

Of course it is to be recognized at once that the quantity of copper used in the construction of a steamship varies widely according to the character of the vessel, and chiefly according to the following points:

1. The specifications: One set of specifications may require the use of copper for piping, another galvanized iron. One may call for bronze propellers, another for cast steel.

2. The horsepower: The major demand for copper in the ordinary merchant vessel is in connection with the machinery, and it will readily be seen that a vessel of large horsepower would have vastly more copper than a low-powered vessel.

3. Character of vessel: A vessel for carrying passengers usually has considerably more copperwork than an ordinary cargo-carrying vessel.

Generalizing, however, for the ordinary first-class cargo vessel having about 10,000 tons dead weight, engines of 3,000 to 4,000 i.hp. and speed of 12 to 14 knots, the requirement for copper and the copper content of brass, bronze, etc., ranges from about 100,000 lb. to about 200,000 lb. A ship of 10,000 tons d.w., 3,000 i.hp. and 12-knot speed might be built with the lower of those figures if there were no special requirements as to copper. The upper of the two figures probably represents the maximum that would be used in a ship of this class. Judging from the data supplied by six large shipbuilding companies, the use of 150,000 lb. for a 10,000-ton ship would probably be not far away from the actual average.

The copper is used in the form of brass and copper tubes, condenser tubes, wire, sheet copper, propeller blades and numerous castings made from alloys containing copper. The figures that are stated represent only the quantity of copper purchased by the shipbuilders as raw copper or brass. They do not include the copper in valves, cocks, pumps and many auxiliary fittings that are purchased from other manufacturers. As for the consumption by the shipbuilder himself, the quantity is about equally divided between copper and copper in brass. For example, a concern building a 10,000-ton ship might buy 90,000 lb. of copper and 150,000 lb. of brass. Reckoning the copper content of the latter at 100,000 lb., the total purchase of copper for this ship would be 190,000 lb.

According to the United States Department of Commerce, there were under construction in the private shipyards of this country on Feb. 1, 1916, vessels to the number of 230, with a total tonnage of 901,371. Estimating 15 lb. of copper per ton of shipping, in accordance with our previous deductions, this would imply a consumption of about 13,500,000 lb. for this purpose in the United States. In the United Kingdom 1,506,925 tons are under contract, which would indicate a copper consumption of 22,500,000 lb. The shipyards of Denmark are reported to be fully engaged for over two years. The plants of the Netherlands are filled with orders up to 1918. The Norwegian yards are full. Japan is busy with both naval and merchant work. In France the yards are almost wholly engaged with naval work.

Our figures give merely a small indication of the enormous quantity of copper that is being required for shipbuilding at the present time. The copper consumption for cargo-carrying purposes is enormously increased by what is being used in naval construction, for ships of war require vastly more copper than do merchant ships. For example, a battleship like the U. S. S. Idaho requires 1,500,000 to 2,000,000 lb. of copper and brass.

Hennen Jennings, of Washington, has been playing a prominent part in the efforts of the well-wishers for the Capitol City to prevent the disfigurement of the vista from the Potomac River by the erection of a power house on the Mall. This act of vandalism was schemed by officials of the Treasury Department, aided and abetted by a committee of Congress, and was to be jammed through without reference to the National Commission of Fine Arts. According to this outrageous plan the Washington monument would be flanked by a smoke-belching chimney. Mr. Jennings, as a public-spirited citizen, is doing yeoman work to defeat it. We hope he will be successful.

BY THE WAY

Attorneys for the estate of James B. Haggin paid to the state controller on Mar. 11 a check for $510,000 representing the transfer tax on the estate, which was appraised at $20,558,034. Of this amount $600,000 is represented by bonds of the Cerro de Pasco Mining Co.; $2,000,000 ($3,000,000 par value) in stock of the same company; $4,000,000 in stock of the Homestake Mining Co.; $3,750,000 in stock of the Kern County Land Co., and $3,881,500 in New York City realty. The estate with a few exceptions was divided into five equal parts, left to the widow and other close heirs.

The following list of Mexico's rulers since Diaz, which has been compiled by a daily contemporary, is a useful reference for those who are interested in Mexican affairs:

Porfirio Diaz, resigned May 26, 1911.

Leon Francisco de la Barra, May 26, 1911, to Nov, 9, 1911.

Francisco I. Madero, Nov. 9, 1911, to Feb. 19, 1913.

Pedro Lascurain, president for 26 minutes, Feb. 19, 1913.

Victoriano Huerta, Feb. 19, 1913, to July 15, 1914.

Francisco Carbajal, July 15, 1914, to Aug. 12, 1914.

Venustiano Carranza, Aug. 12, 1914, to Nov. 10, 1914.

Eulalio Gutierrez, Nov. 10, 1914, to Jan. 16, 1915.

Roque Gonzales Garza, from Jan. 16, to Jan 18, 1915.

Venustiano Carranza, Jan. 18, 1915, to ——.

The following New Year's Greeting was addressed to over 100 officers of the Royal Engineers Tunneling Companies, who are members of the Institution of Mining and Metallurgy, by American mining engineers resident in London, and for which the Council recorded its "appreciation of the sympathetic feeling which prompted this graceful act":

Dear Fellow Engineers: Please accept this[1] as a small token of our earnest sympathy and our admiration of the fine spirit with which you are meeting the supreme need of the hour. The war may disarrange, but it cannot break, the bonds of our common profession; and our sincere hope is that whatever sacrifices the new year may exact, you personally may come through safe, and that long before the year be ended you may be able to return to the regular duties from which you can so ill be spared.—American Mining Engineers, Resident in London.

It's the same sort of honest devotion
That's always stood by you before;
When you solved metallurgical problems,
When you put down the deep-level bore,
When you fought with disease in the Tropics,
Won out in the strike at the mines;
It's the same sort of honest devotion
That blows up the enemies' lines.

[1]A box of cigars.

Charles Hayden left on March 20, reports the *Boston News Bureau,* for a protracted trip through South America with D. C. Jackling on the latter's yacht Cyprus. The primary object is to inspect some tin mines in Bolivia which Hayden, Stone & Co. have under option and which they have had engineers examining for the past six months. Were all of the options exercised the combined output would constitute about 80% of the Bolivian production of tin and about 25% of the world's production. The party will visit Peru and various places in Chile, including the properties of the Chile and Braden copper companies. The travelers will then cross on the Transandine Railway from Valparaiso to Buenos Aires, the yacht meanwhile going around through the Straits of Magellan and joining the party on the east coast. Mr. Hayden will also inspect some cement properties which his firm has under option in the Argentine, then proceeding along the Atlantic coast to various cities in Brazil and back to Key West. The entire trip will consume about two months.

Solid steel balls, ranging from 2 to 10 in. in diameter and resembling in every respect the ammunition for big guns of Civil War days, are now being shipped in large quantities from New York for Galveston. Several barges piled high with the steel alongside the steamship "El Dia" loading for Gulf ports started rumors, says the *Sun,* that it was ammunition being shipped by the Government to the American army patrolling the Mexican border. The balls are for use in mills grinding copper ores, and take the place of pebbles formerly imported largely from Denmark for the same purpose. The scarcity of ships and high freight rates incident to the war have prohibited the shipment of pebbles, it being cheaper to have steel balls manufactured in this country. Picking pebbles on the Danish coast is rather stimulating work these days, and the people over there have so many other things to do that our manufacturers are finding an opportunity to ship the steel balls for grinding and crushing not only to Arizona, but also to South American mines. These balls are for the most part high-carbon high-manganese steel, or chrome may be substituted for the manganese.

A valued contributor offers the following, with the special request that we do not refer to it as a Waltmason. "The style," said he, "was used years ago by Horace Smith and others."

Down in our stope, from twelve to one, when half our daily shift is done, the boys get out their dinner pails and have a little party. And ere the meal is quite begun, some joker starts a little fun—some timely jest which never fails to make us all eat hearty. Then topping off with coffee hot, the candle-stubs beneath the pot are used to light our 'baccy pipes, and someone starts a story. Our wit may not be quite refined, yet 'neath it all our hearts are kind, and from our little noonday talks each learns some kinks on mining. But next month all this will be changed; we hear the company's arranged a contract with a high-priced man who operates on some new plan to teach us miners how to work and tie a most unwelcome can on everyone who seems to shirk. Now Jerry Rowe, who moves so slow, will surely be the first to go. His job is tinkering the chutes, which seldom need repairing; but not so many months ago old Jerry saved twelve men, you know, by one brave deed of daring. Old Jerry's job looks like a cinch, and if they're going to squeeze and pinch expenses down in every way, the chutes will be neglected. The air for every drill and winch will measured be, and those who flinch from rendering their account each day will promptly be rejected. How wonderful will be our mine, when each man's boots must bear a shine and every miner on the job must prove that he's proficient. We'll simply have to get in line; each minute's loss incurs a fine; a wrist watch or a handy fob may make us more efficient. I saw the engineer last night and watched him as he stopped to light a fancy gold-tipped cigarette, all labeled with his monogram. He wasted sixteen matches ere the stink-stick left his tender care. If that's his style, I dare to bet, efficiency ain't worth a damn.

We admire greatly the versification, but we deplore the sentiments. However, our poet expresses one point of view, and we are glad to afford him a hearing, feeling that we but do our duty in giving both sides a chance. But we may offer the suggestion that the proper place for Jerry Rowe is the Watertown arsenal, where the use of stop watches is forbidden by act of Congress, and not in a modern mine.

Interfacial Tension in Flotation

By H. J. Stander*

SYNOPSIS—An explanation of the action of oils and acids in flotation based on surface electric charges and interfacial tension. The latter is a force that has only rarely been taken into consideration in the discussion of flotation phenomena.

Judging from the various articles that are appearing in the technical press dealing with oil flotation, it seems to me that some of the most important phenomena have been overlooked. In this brief discussion I shall endeavor to explain the parts that both the acid and the oil play in oil flotation, although one must remember that splendid results are being obtained without the use of acid. At some of the largest mills where flotation concentration is practiced, no acid is being used and the results are excellent, whereas only such oils as pine tar and coal tar are used. From the experiments that have been carried out in my laboratory, it is quite clear that a froth of a more selective character can be made by the addition of a very small amount of acid, as was pointed out by Donald G. Campbell.[1] He writes: "As acid is added, the percentage of recovery may be diminished also, but the concentration is much more satisfactory."

The oil is the prime factor to be considered, and experiments show clearly that the various oils do not perform the same function in flotation. Up to the present writers on flotation have been inclined to group all the oils in one class, all performing a similar function in the flotation phenomena. It is on this point that I wish to lay special emphasis.

It will be noticed that when an oil like pine tar is added to water through which a large number of small air bubbles are passing, the bubbles decrease in size and increase in number, thus increasing the total exposed bubble surface. A certain amount of this oil must go into solution, because the surface tension of the water must necessarily have been changed; and that some did go into solution is further brought out by the fact that when this oil is used in conjunction with some other in the formation of a froth, very little of the pine tar goes to to the concentrates, whereas a large percentage of it will be found in the tailings. From these two striking experiments one feels inclined to say that it is not so much the actual bubbles of pine tar that help in flotation as it is the change in surface tension brought about by this oil. In other words, a solution of water and pine tar and the sulphide particles have a stronger interfacial tension than that existing between the surfaces of water and sulphides. This particular oil will also stimulate the carrying of colloids into the froth, whereas the opposite happens when oils such as coal tar are used. Expressing it that the pine-tar froth acts as a magnetic film for colloids may not be correct, as the froth itself does not contain a great percentage of the pine tar used, but it is still more difficult to explain the phenomena by the electrical theory. It seems then as if the following theory is the only one that will explain the occurrence of these phenomena:

The tension between the solution and the sulphides has its highest value when the solution is made of water and a small quantity of pine tar, also that this particular solution and colloids have a stronger interfacial tension than a solution of coal tar in water and colloids. As these interfacial tensions increase, the sulphides and the colloids must tend to leave the solution medium and to approach the froth or oil medium.

For these solid particles to accomplish this transference by virtue of the difference of these various interfacial tensions is quite impossible; but when the oil is thoroughly distributed throughout the system and all such particles of oil rise, at some or other time of their rapid travelings, to the froth or oil medium, this act of transferring from the solution to the oil is made much easier, and these sulphides receive help even far beyond this when oil particles receive the support of the lifting power of a great quantity of oil bubbles, on account of the adhesion of air and oil surfaces.

That the air and oil particles in the solution carry static charges of electricity is something still to be proved. From where do they get their charge? It seems as if the only possible electrical charge that these bubbles can carry must have been the result of friction produced as the air particles are forced through the screen or canvas and by the mechanical agitation. Again, when the air or oil particle, or perhaps the air particle coated with an oil film, carries such statical charge of negative electricity and attracts, or is attracted by, the sulphide particle carrying a positive charge, neutralization will follow, but what happens at just this stage? That the oil, air and mineral particles are now much closer together is quite evident, but that the surface tension and adhesion will have to do the work from this stage on is just as evident, inasmuch as the oil has now a better chance to wet the mineral particles. It seems quite reasonable to say that the gangue particles will have been given a negative charge at the same time that the sulphides received their positive charge and that neutralization of the charges of these two different kinds of particles can take place just as easily as that of the oil, air and sulphide particles.

A Theory for the Origin of Electrical Charges on Mineral and Gangue Particles

A difficultly soluble substance, like a sulphide, may sometimes be made to go into solution to an extent greatly beyond its true solubility. If in such a case a supersaturated solution is not formed, but the substance has merely gone into solution beyond its degree of solubility, the substance is said to be in the colloidal form. I think it is necessary at this point to state that wherever the word colloid is employed, it is used in the strictly chemical sense.

Stieglitz defines the colloidal condition as "the condition of an insoluble substance in which, as far as ordinary observation and the common methods for separation of heterogeneous phases (filtration, sedimenta-

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[1]"A Study of Oil Flotation," "Columbia School of Mines Quarterly."

tion, etc.) are concerned, the substance appears to be present in a homogeneous clear solution, whereas in reality it is present in a heterogeneous mixture. An extremely finely divided solid suspended in a liquid and an emulsified liquid suspended in another liquid are the most common types of such mixtures." In the case of flotation it is quite evident that a colloidal condition exists between the very finest of the sulphide particles and the water, and also between the water and the oil. One can, of course, see that the major part of the particles that rise are too large to exist in such a colloidal condition. To convince ourselves that such a colloidal condition was produced, it is only necessary for us to examine the concentrates. One of the greatest troubles in some of the flotation plants is the drying of the concentrates. The sulphides and water appear to have formed a colloidal solution, and this explains the trouble encountered in the process of dehydration.

Electrical Charges on Colloids

It has been proved that the suspended particles of a great group of colloids carry electrical charges. Stieglitz tells us that in the colloidal suspension of arsenious sulphide, the sulphide particles carry a negative charge and the solution a positive. These charges are reversed in the case of some colloids. As to the source of the electrical charges on colloids, there are two prominent views. These two theories are (1) that partial ionization of the colloidal suspension produces the electrical charge and (2) that the charge is due to what is known as contact or surface electricity. It is not my intention, however, to discuss these theories, as some good material can be found on this topic.

What interests us here is that basic colloids receive a positive charge, while acid colloids assume a negative charge. It is significant that colloidal silicic acid changes its charge from positive to negative, according to whether the solution is acid or basic. It may be well to state here that the gangue, or silica, when in a very fine state and in such a solution, will probably not exist totally in the anhydrous form, but that some of it, perhaps a very small percentage, may appear as silicic acid.

If these characteristics hold good in the case of what have been termed colloids in some previous articles that have appeared, an explanation for the selective action brought about by the use of acid has been found.

I feel confident that this colloidal theory explains fully the origin and existence of an electrical charge on the sulphide and slime particles that are fine enough to exist in a colloidal condition, and that a colloidal condition does exist, because of the presence of both a certain amount of very finely divided solid particles in a liquid, and an emulsified liquid; the oil, suspended in another liquid—the water. From this it is quite evident that the electrical charges are present and that they can be reversed in some cases.

One can see how such opposite electrical charges on the various particles will serve as agents to bring together these particles that appear in the froth—that is, the sulphides, oil and air bubbles, and sometimes the colloids—but I do not see how the electrical theory can explain the action of the various classes of oils. Here again, I believe it is (1) the miscibility and relative surface tension, or interfacial tension, of oils and water and (2) adhesion between oil and air particles that underlie the whole principle. It is quite clear that the froth is stimulated and made more permanent by the addition of an oil and that the permanency will depend on the quantity and kind of oil used.

We know that when sulphide particles are placed in a watch glass and a drop of oil added to them, the oil seems to stick to, or wet, these particles, whereas it will do the contrary when added to a group of quartz particles. The only explanation I can find for this is the relative surface tension, or what should be called the interfacial tension, and adhesion of the substances used. When one finds a substitute for oil in this similar experiment, one will have found a partial substitute for oil in flotation. Such a substitute will not be able to do the work of all the oils, because I believe that it is on account of the differences of the interfacial tensions and of the forces of adhesion, and perhaps also on account of miscibility, as manifested by the various oils, that it is possible for us to bring about selective flotation and to carry colloidal materials into the froth or into the tailings, according to where we want them.

American Smelting and Refining Company's Report

The report of the American Smelting and Refining Co.'s activities for 1915 has just been presented, and it shows a large number of interesting facts. The report covers the financial situation and the general position of the company's properties during the year.

The combined income account for 1915 and a statement of the consolidated assets and liabilities of the American Smelting and Refining Co. and its subsidiary companies at the close of the year are presented in their usual form by the board of directors. The earnings of the various properties of the company, after deducting expenses, fixed charges and taxes, show an increase over the year 1914 of $5,430,504.99 and aggregated $16,242,420.08.

From this amount, there has been deducted the usual charge for depreciation and for depletion of ore reserves, $1,839,686.80; appropriation for employees' bonuses, $445,000; appropriation for pension fund, $100,000; appropriation for welfare work, $250,000 and revaluation of investment securities and other profit and loss charges, $554,428.68; leaving total earnings applicable to dividends of $13,053,304.60.

Preferred-stock dividends for the year amounted to $6,001,844, leaving $7,051,460.60 applicable to dividends on the common stock—in excess of 14%. The regular quarterly dividends on the common stock at the rate of 4% per annum were paid, amounting to $2,001,080. The balance of $5,050,380.60 was carried to profit and loss account. It was thought wise by the directors to make special charges to profit and loss account as follows: To credit of property account, $1,100,000, and to reserve for enlargement and extension of the business of the company, for which special appropriations have aleady been made for construction which will be completed during the year 1916, $3,900,000.

By a comparison of the semi-annual report of the company, as of June 30, 1915, with this yearly report, it will be seen that the net earnings of the mines, smelteries and refineries for the earlier six months' period were $6,002,394.56, and for the last six months, $10,-

455,194.70. While this increase is due, to a considerable extent, to the enlarged production of mines caused by the abnormally high prices that have prevailed, the company has also benefited largely by the improved and diversified installations covered by the capital expenditures of the past few years. The directors report that the properties in Mexico were, as a whole, unprofitable and unproductive during the past year. During the first six months the smelters and mines near Chihuahua were operated at partial capacity, but were obliged to close down during the summer, and none of the properties were operated until late in the year, when the Monterey and Matehuala plants were started up. All other properties remain closed.

The directors have deemed it wise to add materially to the property of the company in Mexico during this last year, and will no doubt continue this policy. New property has been purchased and new plants erected during the year at a cost of $2,691,361.72. Extension and enlargement of plants have called for a further expenditure of $1,049,102.84.

In addition to the mining properties that have been purchased during the past year, the company has constructed a tin-smelting and refining plant at Perth Amboy, zinc-smelting plants at Salt Lake City and at Sands Springs, Okla., and a new copper refinery at Tacoma. With the completion of the construction already covered by appropriations, the company will have a smelting and refining capacity of 1,000,000,000 lb. of electrolytic copper per annum. The new tin plant at Perth Amboy was completed late in the year, but its operations were delayed by the closing of the Panama Canal. The production of refined tin will begin about Apr. 1 of this year.

During the first six months of 1915 the shipment of ores was greatly restricted, and in the semi-annual report attention was called to the decrease in metal stocks, due to this cause, amounting to nearly $7,500,000. There has been, however, a great and constant increase in ore production during the last portion of the year, so that ore stocks have returned nearly to the normal. The increase in amount of business done during the latter part of the year is also indicated by the value of metals on hand in process of smelting and refining, payment for which is to be made in refined metals and not in cash, amounting to nearly $35,000,000, or an increase of $16,000,000.

Attention was called in the last annual report to the strong position of the company as to cash in bank. This has continued to increase and at the close of the year amounted to $18,642,460.41, an increase over the preceding year of $10,607,682.29. Of this, $4,000,000 is loaned against Stock Exchange collateral. The increase in cash was partly the result of the payment of loans secured by copper in process of refining, amounting to $4,453,292.45. The accounts and notes receivable are largely represented by products in transit to customers.

During the year, there has been added to the cash working capital of the company the sum of $2,903,737.84, derived as follows: From net earnings (before deducting depreciation to property) less fixed charges and dividends, $6,890,067.40; less amount expended on the property of the company for investments and for bonds and stocks purchased for retirement, $3,986,329.56; leaving a net increase in working capital of $2,903,737.84. There was repaid to the company on account of loans secured by copper held as collateral, the sum of $4,453,292,45. Metal stocks have been converted into cash and net current liabilities have been increased to the amount of $3,250,652, and there was $8,034,778.12 cash on hand at the beginning of the year. At the end of the year the cash on hand and in bank subject to check, together with loans secured by stock exchange collateral, aggregated $18,642,460.41.

STATEMENT OF CASH RECEIPTS AND PAYMENTS

Balance on hand, Jan. 1, 1915		$8,034,778.12
Receipts:		
From sales of metals*		
Gold	$54,952,106.17	
Silver	35,454,210.02	
Lead	27,027,012.41	
Copper	92,356,662.40	
Zinc	4,372,145.01	
Other metals	1,338,105.10	
Total	$215,500,241.11	
From mining properties	4,289,619.79	
From manufactured products	4,103,228.83	
From miscellaneous income, rents, interest, commissions, etc.	1,791,511.17	
Total from sales and miscellaneous income	$225,684,600.90	
From demand loans	4,453,292.45	
From investments	203,320.00	
From increase of net current liabilities	1,939,968.48	
Total cash receipts		232,281,181.83
Total cash to be accounted for		$240,315,959.95
Cash Payments:		
For ore and bullion purchased, expenses and taxes	$207,755,067.75	
For expenditure on property	3,740,464.56	
For interest on bonds	770,370.68	
For dividends to stockholders	8,002,924.00	
For American Smelters Securities Co. debenture bonds purchased	$738,500.00	
Less paid for by American Smelting and Refining Co. common stock	108,000.00	
	630,500.00	
For American Smelters Securities Co. preferred "A" stock purchased	180,200.00	
For advances to affiliated companies	38,281.24	
For transfer to special funds	555,691.31	
		221,673,499.54
Balance Dec. 31, 1915:		
Cash on hand and in bank subject to check	$14,642,460.41	
Loans, with stock exchange collateral	4,000,000.00	
		$18,642,460.41

*Does not include value of metals treated and delivered in kind aggregating $16,191,457.55.

OPERATING STATISTICS

Metal production and other income:	Value 1914	Value 1915
Gold	$52,515,549	$55,239,405
Silver	42,690,226	38,007,727
Lead	24,551,632	27,279,350
Copper	71,712,527	89,027,089
Other metals	2,431,410	6,105,291
Value of products of company's mines	3,135,809	3,820,166
Value of manufactured products	2,665,958	3,507,276
Miscellaneous income	1,222,514	1,791,511
Total volume of year's business	$200,925,625	$224,777,815
Net earnings available for dividends	9,031,565	13,053,304
Percentage of net earnings to volume of business	4.494	5.807
Employees:		
Total number of men employed (excluding Mexico)	12,179	15,556
Total wages and salaries paid (excluding Mexico)	$10,212,591	$11,392,503
Average wages per employee per 8-hr. day	$2.33	$2.44
Tons of ore mined	1,266,702	1,578,611
Tons of coal mined	257,942	214,822
Tons of charge smelted	4,171,258	4,153,092
Tons of bullion refined	588,718	579,080
Tons of coke produced	129,650	120,660
Tons of coal used	544,619	604,204
Tons of coke used	447,761	401,511
Bbl. of oil used	976,528	829,304
Cu.ft. of gas used	7,430,300	1,071,593,000
Oz. of gold refined	2,540,911	2,672,702
Oz. of silver refined	77,604,483	76,117,453
Tons of lead refined	316,591	296,986
Lb. of copper refined	529,686,000	551,798,000
Lb. of metal products manufactured	40,122,817	37,835,899
Lb. of zinc refined	15,748,000	36,154,000
Lb. of acid	24,234,000	34,124,000
Lb. of nickel	356,187	1,120,556

PERSONALS

H. C. Enos is examining properties in the Joplin District in Missouri.

F. C. Alsdorf is examining properties in Nevada and Northern California.

James M. Platt has arrived at Alamosa, Colo., from Mexico City. He will make Alamosa his headquarters while in the United States.

T. W. Gibson, Deputy Minister of Mines for Ontario, has sailed for England in connection with the work of the Ontario Nickel Commission.

Leon J. Pepperberg, consulting geologist and engineer, announces the removal of his office to 718 New Call Building, San Francisco, California.

Clive S. Newcomb arrived in New York from Mexico City on Feb. 22. Temporary address, with Seymour & Seymour, 120 Broadway, New York.

Heath Steele, for several years with J. R. Finlay, has opened an office as consulting mining engineer, Room 1308 at 60 Broadway, New York.

Herbert G. Officer has taken charge of the development of the copper property of the American-Canadian Mining Co., near Pictou, Nova Scotia.

Fred D. Wilkerson has been appointed general manager of mining and transportation of the Brier Hill Steel Co., Youngstown, Ohio, and Clyde Haynes has been made his assistant.

Dr. Hjalmar Lundbohm, who has long been a prominent figure in the Swedish iron-ore industry, is now a visitor in the United States. He is making a short stay in New York.

B. M. Snyder, of Los Angeles, Calif., is consulting engineer to the Magdalena Copper Co., Magdalena, N. M., and the Victor Reduction Co., Victor, Mont., and is now at the latter property.

W. A. Neill, for many years engineer of the Mining Department of Allis-Chalmers Co., has moved to Denver and become associated with the Dorr Cyanide Machinery Co. as mechanical engineer.

Matthew J. Scammell, who has been superintendent of blast furnaces of the Maryland Steel Co., Sparrows Point, Md., has been made general superintendent of the company. This is a newly created position.

Scott Lings, managing director of the Oceana Consolidated, a London financial house extensively interested in the development of Canadian oil fields, has gone West to inspect some oil claims in Southern Alberta, where drilling is being actively undertaken.

W. L. Saunders, C. F. Rand and Bradley Stoughton, representing the American Institute of Mining Engineers, were members of the committee of National Engineering Societies which reviewed the 22d Corps of Engineers, N. G. N. Y., Mar. 14, at the armory in New York.

F. A. Schroeder, formerly with the United Engineering and Foundry Co., Youngstown, Ohio, has been appointed chief engineer of the open-hearth steel plant of the Youngstown Iron and Steel Co. at Haselton and also of its sheet mills and pressed steel department at Youngstown.

Roy E. Brakeman, assistant chief engineer of the steel works and the blast-furnace department of the Tennessee Coal, Iron and Railroad Co., has been appointed chairman of the Birmingham section committee of the American Society of Mechanical Engineers. Paul Wright is secretary.

Emmett B. Carter, chief engineer, Midvale Steel Co., Philadelphia, has been appointed chairman of the Philadelphia section committee of the American Society of Mechanical Engineers. William R. Jones, engineer of construction, University of Pennsylvania, is secretary of the committee.

C. A. Warring and D. Huguernin, mining engineers, as field assistants for the State Mining Bureau, are visiting the Death Valley region and will give special attention to investigation of the development and production of antimony and gold. There is a good deal of mining going on in that region, some of it actually on the floor of Death Valley.

C. F. Kelly, of New York, vice-president of the Anaconda Copper company and president of the International Smelting Co.; John Gillie, of Butte, general manager of the Anaconda, Frederick Laist, of Butte, metallurgical manager of the Anaconda, L. O. Evans, of Butte, general counsel of the Anaconda, P. L. Foster, of New York, American director of the London Exploration Co., and W. D. Thornton, of New York, vice-president of the Inspiration Consolidated Copper Co., visited Ray and Hayden, Arizona, last week, inspecting the Ray Consolidated mines and mill and the Hayden plant of the American Smelting and Refining Co. The party went to Globe and Miami from Ray and also plan to visit Douglas and Bisbee while in the state.

F. H. Brownell, of Tacoma, former representative of the Standard Oil interests in the Northwest, has been elected president of the Tacoma Smelting Co., succeeding W. R. Rust, who resigned several months ago. The position carries with it the supervision of the different Guggenheim mining operations in Alaska and the Cœur d'Alenes, and for this reason he will not assume active control of the smeltery, as H. Y. Walker, general manager of the company, will be the practical executive. Mr. Brownell is a director of the American Smelting and Refining Co., and recently was made president of the Federal mining company, succeeding Harry L. Day, resigned.

The Cleveland Cliffs Iron Co. announces several changes among its mining officers on the Marquette Range in Michigan. George R. Jackson, who has been in charge of the corporation's operations in the Swanzey district ever since the first property, the old Princeton, was acquired there, goes to Negaunee, to succeed S. R. Elliott, who was promoted to the position of general superintendent, with headquarters in Ishpeming. Mr. Jackson will be in complete charge of all of the company's Negaunee mines, which include the Maas, Negaunee, Jackson and Athens. Mr. Jackson will be succeeded as superintendent in the Gwinn district by W. W. Graff, who has been in charge of operations at the company's North Lake properties. Mr. Graff will be succeeded as superintendent in the North Lake field by John M. Bush, for some time past in charge of operations at the Republic. Charles Stakle, who has been the company's head mining engineer, under James Jopling, for a number of years, is to be superintendent at Republic.

OBITUARY

Edward L. Young died Mar. 16, in New York. He was manager of the New York office of Takata & Co., engineers and contractors, of Tokyo, Japan.

Erasmus D. Leavitt, who attained great prominence as a mechanical engineer, died at Cambridge, Mass., Mar. 11, aged 79 years. He entered the Naval Academy in 1861 and after graduation was detailed to service in the institution as an instructor in steam engineering. For many years he was consulting engineer for the Calumet & Hecla Mining Co., designing much of the equipment now in use at Calumet, Mich. He was also advisory engineer and designed machinery for the Bethlehem Steel Co. and for mining concerns in South Africa. He leaves three daughters.

Thomas Steveson, California pioneer of 1849, died at Berkeley, Calif., Mar. 12. He was born in Lynn, Mass., and was among the first to join in the rush to California, going around the Horn in a Boston clipper ship. He went into the mines in Tuolumne County and later engaged in newspaper work at Stockton and again resumed placer mining after he had founded the stage line running from Stockton to Jamestown, Sonora and other points in the Tuolumne district. Business interests and material inclination required that much of his time be spent in San Francisco during the days of Vigilantes, of which organization he became a member. In 1882 he became a resident of Berkeley at the home of his daughter Mrs. Georgia Welsh. Steveson was 88 years old.

Captain Hiram S. Chamberlain died at Chattanooga, Tenn., Mar. 15 aged 81 years. He was president of the Roane Iron Co. and was connected with many other business enterprises. He was one of the pioneers of the iron industry in the South and was associated with Mayor Abram S. Hewitt, Colonel R. T. Wilson, Colonel Charles M. McGhee, and other wellknown New Yorkers. Captain Chamberlain was born on a farm near Franklin, Portage County, Ohio. In his youth he attended Hiram College, of which the late President Garfield was then president. When the Civil War began he enlisted as a private in the Union army, but was soon promoted. His campaign duties brought him to the South, where he settled, first at Knoxville, later moving to Chattanooga. Associated with General John T. Wilder, he was the first person to build a coke furnace south of the Ohio river. During his residence of about 45 years in Chattanooga Captain Chamberlain was connected in an official and advisory capacity with many of the leading enterprises of the city. For many years he was president of the Associated Charities of the city, and was chairman of the Board of Trustees of the University of Chattanooga. He was a member of the American Institute of Mining Engineers, the Society of the Army of the Cumberland, and the Ohio Commandry of the Loyal Legion.

Editorial Correspondence

SAN FRANCISCO—Mar. 15

The Reconstructed Tungsten Mill of the Atolia Mining Co. is about completed and ready for resumption of operation. The mill destroyed by fire on Jan. 24, was partly new. The present one is of increased capacity. The ore is hauled from mine to mill on 4-ton trucks which deliver 100 tons a day. From a large bin the ore is fed to a 10x18 Joshua-Hendy jaw crusher; then passes by bucket conveyor to the hopper feeding the rolls for finer crushing. Half of the product is fed into a single mill unit, composed of two 5-ft. Huntingtons. The discharge passes over two large Deister roughing tables, where the most of the tungsten is extracted; the residue passes on to the Frue vanners. The other half of the rolls product goes to the 8-ft. Marcy ball mill whose capacity is 30 to 40 tons in 24 hr. The 30-mesh pulp is discharged onto a Deister roughing table and then passes to a Dorr classifier. The slime from both units is thickened for concentration by use of three 8-ft. Callow cones and then passes over three double-decked sliming tables; thence to three double-decked Deister tables, whence the tailings are carried to the pond. The plant is operated by about 25 electric motors, each unit of machinery being driven by a separate motor. The mill will use 30,000 gal. of water when running full capacity and will produce 5 to 7 tons of concentrates every 24 hr. The new electric hoist will be installed on the 900-ft. level of No. 1 mine, to be used in sinking a winze on the ledge for prospecting the vein at greater depth.

BUTTE—Mar. 17

Four-Hour Fire-Fighting Shifts are engaged in fighting the fire which caused 21 deaths a month ago at the Pennsylvania mine. Cement bulkheads are being constructed to wall off the fire at every weak point, and diamond drilling into the fire zone, to provide channels for water, is being carried forward with all possible speed. In spite of the fact that the men working closest to the fire wear helmets and are protected in every possible manner, the gas is so treacherous that quite often men are overcome and have to be taken to the surface and revived. The stope in which the fire is confined is called the Big Woods, because of its width, which necessitated the use of a great amount of timber.

DENVER—Mar. 18

Cripple Creek Gold Discoveries during the past week include the strike on the southern slope of Mineral Hill, a short distance from the City of Cripple Creek in the granitic area to the northwest of the recognized gold crater. The reported strike of 3 ft. of high-grade ore on the 1,500 level of the Lee shaft on the Isabella property was verified. The raise from the station established in the Roosevelt tunnel directly beneath the Elkton shaft was started but the work will be exceptionally difficult for the reason that it will be done in exceedingly wet ground.

Tungsten Is Talked About by Everybody in Colorado nowadays. This precious metal, worth more than silver, is being prospected for throughout the state and discoveries are reported almost daily in areas in which the minerals of this metal had never before been recognized. The Silverton district is trying hard to give the Boulder district a close run this coming season and, if reports are to be accepted, the chances are good for accomplishing this end. Geological conditions in the two areas are totally unlike, although both districts possess typical ore-bearing veins.

El Paso Consolidated Gold Mining Co.'s Annual Meeting, held this week in Denver, resulted in a victory for the so-called New York group of stockholders who voted 229,000 of the 317,000 shares represented at the meeting. The Starke faction, known as the grievance committee, failed to carry any of its policies. Election of officers and directors resulted as follows: Judge H. McGarry, president; Fred W. Bailey, vice-president; George M. Miller, second vice-president; Daniel Thatcher, secretary-treasurer; J. K. Corbiere, W. C. Sherwood, George W. Gano, R. M. Rankin and A. E. Carlton. A contract committee, consisting of five directors, will hereafter supervise the sale of all products shipped from the mine. The general office of the company has been ordered moved from Denver to Colorado Springs. The indebtedness that stood at about $70,000 a year ago, has been reduced to $22,500, and the mine is reported as now making a profit of about $5,000 per month. Following the meeting, an announcement was made that a large flotation mill is contemplated but that nothing will be done toward its erection until more is known regarding the practical application of this process to Cripple Creek ores.

SALT LAKE CITY—Mar. 17

Suit has Been Filed by the Keystone Mining Co. of Park City against the Silver King Coalition Mines Co. for alleged unlawful removal of ore from its ground in the Crescent Hill section of the camp, near Thaynes Cañon. The amount named in the suit is $50,000 which is said to be only a nominal value for the ore, it being impossible to give an accurate estimate. The Keystone will doubtless press its suit along lines of the recently concluded Conkling-Silver King Coalition case.

The Local Division of the United States Weather Bureau, acting in conjunction with the water works department of Salt Lake City will make a survey of the snow supply in City Creek Cañon, the week ended Mar. 18. There has been heavy snowfall this year, with the snow well packed; and a plentiful supply of water is assured for mining during the summer months.

After Controversy, with the Federal Government extending over a period of nearly ten years, title to 4,106 acres of valuable coal land near Huntington, Emery County has by the decision of the Secretary of the Interior been awarded the Freed heirs of this city. This land, at the time of purchase valued at $40,800 by the government, is estimated to be worth from $3,000,000 to $4,000,000. In January, 1916, C. M. Freed, since deceased, various members of his family, and several employees, ten in all, filed application to purchase 160 acres of land each, in the Carbon-Emery field. In the same month sixteen other applications were made to purchase lands, amounting in all to 2,560 acres, adjoining the Freed entries. The money for the purchase price was loaned by W. G. Filer, the son-in-law of Mr. Freed, who later bought the land from the sixteen entry men and paid off mortgages held by Mr. Filer on the lands. The decision of Secretary Lane, which is final, reverses that of the United States land commissioner, who on May 18, 1912, held that the land should be restored to the federal government. Previously to the decision of the land commissioner on July 13, 1911, the lands had been awarded the claimants by the registrar and receiver of the United States land office here.

TORONTO—Mar. 18

The Nickel Question appears as far from settlement as ever, despite the stand taken by the government and the agitation for compelling the refining to be done in Canada is making renewed headway. A significant feature is that the movement is no longer confined to extreme protectionists and alarmists, but is now backed by several of the leading Liberal newspapers including the Toronto "Globe." It is advocated on patriotic and imperialist grounds, and the charge is made that the International Nickel Co. exacts a much higher price for nickel from the British Government than that paid by the United States Steel Corporation. It is also alleged that the company escapes its just share of taxation owing to the deposits at Sudbury being worked by its subsidiary—the Canadian Copper Co. The latter may sell the ore or matte to the International at a nominal price, though as the Finance Minister has pointed out, the new tax bill as amended provides for such a case by giving the minister power to fix a fair price—as a basis for determinig profits. While so drastic a measure as the absolute prohibition of the export of nickel ore is hardly likely to be the outcome, it appears altogether probable that very strong pressure will shortly be brought to bear upon the government for the enactment of some measure for securing further control of the output and limiting the power exercised by the International. As to the nature of the steps to be taken, much may depend on the recommendations of the Ontario Nickel Commission. It is generally anticipated that its findings will be strongly in favor of encouraging the refining of nickel in Canada, and the fact that the members of the Commission are now in England is not without significance as regards the safeguarding of Imperial interests.

The Mining News

ARIZONA

Cochise County

WARREN DISTRICT MANAGERS of copper companies have increased wages of miners 25c. per shift, making daily wage $5.35, highest ever paid in district. Increase affects about 5,000 men.

Gila County

RAY CONSOLIDATED (Ray)—Is enlarging flotation section of concentrator; present capacity, 8,000 tons daily; 1,500 men now on payroll.

ARIZONA EASTERN R.R.—February report of Globe division shows 7,425 tons copper bullion moved during month. Globe and Miami ore shipments totaled 484 cars, or 23,425 tons.

Mohave County

UNITED EASTERN (Oatman)—Grading mill site in progress; mechanical equipment for No. 2 shaft completely installed; sinking resumed at 60-ft. point, with 800-ft. point as objective.

EDMAIER MINING (Cedar Valley)—East crosscut on 50-ft. level disclosed 4-ft. vein 3 to 5% wolframite, 1 to 3% copper and some gold and silver. Twenty men employed; 25-ton concentrator being installed.

OATMAN PIONEER (Oatman)—Keith & Keith, Boston mining men, have acquired controlling interest from A. L. Burris and Charles Walden, for $250,000. Extensive development planned. E. H. Dawson, general manager.

ADAMS MINING (Oatman)—New corporation organized to develop Adams group of 3 claims adjoining Nellie; capitalized at $100,000, divided into 1,000,000 shares, par value 10c.; officers, E. H. Newlands, president; N. A. D'Arcy, secretary-treasurer and general manager; C. H. Palmer, Jr., and M. Lines, other directors.

Pima County

TUCSON (Oracle)—Concentrator will be installed at Chist group of 9 claims, in Catalina Mountains, 10 mi. from Oracle. Large copper deposit discovered; shaft down 60 ft. in carbonate and oxide.

AMERICAN SMELTING AND REFINING (Sasco)—Has acquired Sasco smeltery from Southern Arizona Smelting Co. under one year lease with privilege of extending for another year if desired; rental, $2,000 per month. Plant originally cost $500,000; closed down since 1910.

Pinal County

LAKE SUPERIOR & ARIZONA (Superior)—Reported reorganization of Lake Superior & Arizona by Gunn-Thompson syndicate, whereby working capital of $50,000 is provided. Will issue 10,000 treasury shares, par value $5, of which Gunn-Thompson takes 7,000 and Lake Superior people 3,000. Ore shipments to Magma mill expected to begin soon.

Yavapai County

COLORADO SYNDICATE (Walnut Grove)—Representatives who for months have been testing placer ground on Fisher ranch planning to install large dredge.

ARKANSAS & ARIZONA (Jerome)—Financial affairs readjusted and C. W. Clark, president, who visited property last week, announced resumption of work in 30 to 60 days. Goodrich-Lockhart Co., of New York, reported now behind company.

CALIFORNIA

Amador County

ONEIDA (Sutter Creek)—Unwatering of lower levels is progressing rapidly. Ore, said to run from $8 to $10 a ton, struck recently. Henry Malloch, San Francisco, manager.

Eldorado County

HOPE MINING CO. VS. N. H. BURGER (Placerville)—Judgment of Superior Court gives possession to the company of the Landecker, Blair, Landecker-Parker placers and the Loomis and Stewart mines; court held that plaintiff had paid whole consideration.

Glen County

CALIFORNIA CHROME (Fruto)—Extraction of ore to begin Apr. 1; hauling to Fruto will begin about May 1. Proposals for bids for hauling are based on production of 50 tons per day. Company will guarantee minimum of 5,000 tons total. Mines located near Millsap; distance to railroad 19 mi. Orebody is large, of which about 3,500 tons mined up to 1893. It has been exposed by quarrying 30 ft. high and 40 ft. wide.

Inyo County

DAISY (Bigpine)—Sinking 800-ft. shaft begun. At depth of 40 ft. a 16-in. shoot disclosed said to assay 70% lead and $7 gold. Property reported controlled by Hercules Mining Co. of Cœur d'Alenes, Idaho. Operated by F. M. Bedell and associates.

NATURAL SODA PRODUCTS (Keeler)—Company operating new soda plant on Owens Lake has recovered from financial difficulty and is installing improvements to cost $40,000, including railway-track extension and machinery for treatment processes. Plant expected in operation by April. About 40 men employed.

Kern County

PAYMASTER (Randsburg)—Regular monthly run of 60 tons yielded $3,800; ore plating, $63 per ton. Shaft sunk 75 ft. and drift run 80 ft. on vein.

Nevada County

NORTH STAR (Grass Valley)—Recent quarterly report shows 24,414 tons ore hoisted, as against 25,325 tons for preceding quarter. Miner's shifts were increased from 4,133 to 5,081. Tons of ore per miner decreased from 6.14 to 4.81. Tons of ore hoisted per square foot of stoping decreased from 0.415 to 0.352. Stopes narrowed from an average of 4.5 to 3.7 ft., equal to 18%. Efficiency of mine operation being improved by hand-sorting of ore, thus decreasing amount of rock going through mill and increasing per-ton yield. Six men employed at ore-sorting table and about 70 tons waste per day sent to dump.

San Bernardino County

TUNGSTEN GROUND embracing 160 acres in Atolia district, has been leased to S. M. Drager by Frank Moon, of Los Angeles. A small ledge and some float make property attractive. Mr. Drager is subleasing ground on 15% royalty for periods ranging from 3 to 7 months.

ATOLIA (Atolia)—U. S. patents granted for 49 claims.

TERRA MARIA (Atolia)—Fourteen tons tungsten ore recently sold to local buyers for $4,350. Ore came from shaft less than 50 ft. deep, at whose bottom vein is 3 ft. wide showing high-grade scheelite.

QUIRK-STATTS (Atolia)—Lease on Modern group has struck vein of scheelite 1 ft. wide with 4-in. streak or high-grade in hanging. Shaft sunk 45 ft. and crosscut 12 ft. Report important because of very little prospecting done in northeast side of district.

Sierra County

HARTMAN (Pike City)—Gold-bearing ledge 3 to 5 ft. wide uncovered on Alleghany serpentine belt. Much rich float indicates possibility of another high-grade producer. Henry Hartman, owner.

Siskiyou County

MARYSVILLE GOLD DREDGING CO. (Marigold)—Operating machinery for No. 5 Dredge which is being reconstructed of all-steel is arranged and construction being rapidly forwarded.

Solano County

HASTINGS (Benicia)—Quicksilver mine reopened by W. T. Garrett and associates of San Francisco.

COLORADO

Clear Creek County

NEW ERA (Freeland)—Rich strike made on Great Western vein of steel galena from 10 to 18 in. wide. A 5-ton trial shipment indicated settlement value $70 a ton in gold, silver and lead. New ore shoot was opened below tunnel level and appears extensive.

Park County

LONDON (Alma)—Reported producing 500 tons monthly, averaging over $100 per ton under management of Charles P. Aicher. Company planning to drive tunnel to tap orebodies 600 ft. below present workings; 100 men employed.

San Juan County

HERCULES (Silverton)—Winze sunk on Dora vein, 1,100 ft. in from portal of main tunnel to be unwatered. Necessary equipment ordered and men at work on preliminary construction. Considerable development planned for lower workings.

San Miguel County

FEBRUARY ORE SHIPMENTS from Telluride were as follows: Tomboy, 58 cars; Smuggler-Union, 54; Liberty Bell, 13, and Columbia, 1 car; total, 126 cars.

SILVER BELL (Ophir Loop)—New raise now 500 ft. above tunnel level, opening a streak of tungsten.

SMUGGLER-UNION (Telluride)—A 30-ton flotation unit installed for treatment of ore from Black Bear and Humboldt properties. If practical tests now planned are successful, company will probably install larger plant.

IDAHO

Shoshone County

RICHMOND (Adair)—Shipping high-grade copper ore to smelter regularly. Plans expenditure of about $15,000 for equipment, including 800-ft. aërial tram. Martin Woldson, Spokane, is president.

ANACONDA COPPER (Wallace)—Has started development on recently acquired Douglas mine on Pine Creek with W. J. Kelly, of Anaconda, in charge. No. 2 and No. 3 tunnels will be cleared out and connected by 150-ft. raise at point 700 ft. in from portal of No. 3. The shaft sunk 180 ft. from No. 3 tunnel will be pumped out and vein explored at depth.

ILLINOIS

U. S. GYPSUM (Chicago)—Increase of capital stock from $8,500,000 to $10,000,000 ratified by stockholders. Increase will be all preferred. Proceeds will be used for purchasing new property. Representative William V. Shoemaker, of Chicago, states company will at once construct gypsum mining plant on Terence McDonald ranch, on Spring Creek, 9 mi. below Lewistown, Fergus County, Mont. Ground adjoins Hanover Gypsum Co., which recently began development and construction work. Gypsum bed said to be 6 ft. thick, good quality. Company expects production by July.

MICHIGAN

Copper

MOHAWK (Mohawk)—Crushed during February 56,608 tons producing 1,428,700 lb. copper, or about 25 lb. per ton, as against 1,280,000 lb. for January, with recovery of 22 lb. per ton.

TAMARACK (Calumet)—Circular issued to Tamarack stockholders by Calumet & Hecla offers $3,563,486, equivalent to $59 a share for property and assets. Special meeting of Tamarack stockholders called for Apr. 27 to vote on proposition. Calumet & Hecla owns 19,400 of outstanding 60.000 shares of Tamarack and it is reported that this stock will be voted at meeting unless at least three-fifths of other stock is voted in favor of offer.

MONTANA

Fergus County

BARNES KING (Kendall)—Report for February proved a disappointment as to tonnages compared with December and January outputs. At North Mocassin, at Kendall, yield per ton was up to previous months, showing no decrease in quality; 3,513 tons mined and treated with estimated bullion production of $32,000, or average yield of $9.11 per ton. At Piegan-Gloster mill, in Marysville district, Lewis and Clark County, 2,537 tons of ore treated with estimated bullion production of $11,800, yield per ton $4.65. Shannon mine in same district has opened good milling orebody 8 to 10 ft. wide for a distance of 500 ft. on 400 level; car samples averaged $18 per ton. Contract made with Riblet company, of Spokane, for construction of aërial tram from Shannon to Gloster mill, a distance of 13,000 ft.

Lewis and Clark County

MITCHELL GULCH MINING DISTRICT—Big strike reported from Last Hope mine, owned by Mr. Smith, of East Helena, located in this district, 8 mi. east of East Helena. Lead runs from 2 to 4 ft. wide, best ore assaying $130, low-grade $18 per ton, in gold and silver. Previous shipments to East Helena smeltery have given returns from $18 to $50 a ton. A 5-stamp mill on the property will be started soon.

Silver Bow County

NORTH BUTTE (Butte)—At present rate of production output for March will reach 2,250,000 lb. On 700-ft. level new orebody has been opened up that gives promise of being extensive and high grade. Granite Mountain shaft now down to 2.165 ft. It is proposed to sink to 2,600-ft. level.

TUOLUMNE COPPER (Butte)—At annual meeting, most of old directors reëlected. Report of President Hickey showed operations to Dec. 31, 1915, conducted at a loss of $55,000, but in January and February of this year at a slight profit. Ore averaged about 3% copper and 4 oz. silver per ton. All development work has been discontinued and mining is being conducted on 800-, 2,000-, 2,200- and 2,400-ft. levels.

ANACONDA (Butte)—Robert Emmet lodes Nos. 1 and 2 were sold Mar. 15 to company at public sale for $55,000. Company already owned a third interest in No. 1 and a two-thirds interest in No. 2 lode, so that purchase price will be in neighborhood of $30,000. Sale has started rumor that Anaconda company is negotiating for purchase of Gambrinus claim, adjoining Robert Emmet claims and owned by Corbin Copper Co., in order to own contiguous territory in this western section of district. At special meeting of Corbin stockholders sale of Gambrinus was authorized. About two years ago claim was purchased by Corbin company for $100,000 and operated for some time without any visible success. Other reports are to the effect that new company has been formed by some stockholders of Corbin to take over and carry forward development of Gambrinus.

NEVADA

Churchill County

NEVADA HILLS (Fairview)—Sixth annual report gives production as 64,030 tons, in addition to which mill treated 1,418 tons tailings. Total gross product $365,617, or $5.58 per ton; net profit, $39,142, or $0.598 per ton. President Geo. Wingfield states that while mine may continue operation at small profit for several months, its life is limited. Convertable assets are $289,285.

Esmeralda County

JUMBO EXTENSION (Goldfield)—Preliminary estimate for February shows 2,595 tons shipped, having gross value of $79,000. Sampling, freight and treatment amounted to $23,500, smelting losses to $12,000, operating expenses to $18,500, leaving a net realization of $25,000.

FLORENCE (Goldfield)—At recent annual meeting former officers reëlected. Report shows expense of $88,240 with revenue of $56,434 for fiscal year; cash surplus was $95,384. During year 3,194 tons shipped, gross value $55,638, or $17.42 per ton. Development, 3,543 ft., done at cost of $5.03 per ft. Manager's report states large tonnage of low-grade ore blocked out amenable to profitable treatment by flotation.

Nye County

TONOPAH ORE PRODUCTION for week ended Mar. 11 was 8,311 tons, valued at $174,858, compared with 7,846 tons for week previous. Producers were: Tonopah Belmont, 3,173 tons; Tonopah Extension, 1,800; Tonopah Mining, 1,525; Jim Butler, 750; West End, 650; Halifax, 85; Rescue-Eula, 83; North Star, 52; MacNamara, 40; miscellaneous leases, 159 tons.

Storey County

ANDES (Virginia)—Started breaking rock in old stope on 350 level.

SIERRA NEVADA (Virginia)—Ore from No. 1 stope, 2,500 level, stored in mine chutes; winze deepened 5 ft. from stope; bottom in low-grade ore and $50 ore on the foot-wall side.

MEXICAN (Virginia)—West crosscut on 2,500 level shows porphyry and quartz, low assay. Ladders and air pipes placed for 100 ft. in incline winze, 1,600 level. Repairs made on 2,700 level. Mexican mill crushed 406 tons custom ore, gross value about $8,700.

OREGON

Baker County

COUGAR GOLD (Sumpter)—Reported sold to Spokane and Eastern capitalists for $300,000. Extensive mine developments have blocked out considerable tonnage running from $10 to $35. Purchasers contemplate installing new machinery, to cost $25,000.

TENNESSEE

Polk County

CARBOLITE CHEMICAL CO. (Copperhill)—This T. N. T. plant using acid from Tennessee Copper Co.'s works destroyed by fire on Mar. 21. Plant is situated about midway between Copperhill and Ducktown, hence no damage done to mines, smeltery or acid plant of Tennessee Copper Co.; George Strohl, assistant superintendent of mines for latter company, was struck by flying débris and died a few hours later.

UTAH

Beaver County

KING DAVID (Frisco)—At recent meeting directors decided to resume work, for which an assessment of ½c. a share was levied—to provide a fund of $5,000. Property adjoins the Horn Silver on west, and a new shaft is proposed about 200 ft. from boundary line. The Knights and Salt Lake men are interested.

Boxelder County

LAKEVIEW (Promontory Point)—Strike made recently 1,500 ft. south of main zinc workings, where lead ore was opened on limestone-shale contact. Wages increased to $3.50 and $3.75 a day. Western Zinc Co. lessees on a part of the Lakeview ground will ship 10 cars in March; company will market approximately 20 cars, worth about $2,000 a car at Saline station. At annual meeting, W. A. Perkins elected president, and S. S. Arentz, manager from the beginning of work, vice-president.

Juab County

IRON BLOSSOM (Silver City)—Sinking of winze, which, starting at the 600, has reached the 1,000, from the latter level to the 1,100 is in progress. On 900- and 1,000-ft. levels, stoping of ore from new copper strike under way. Several cars good grade mined.

Salt Lake County

SOUTH HECLA (Alta)—January shipments amounted to 600 tons; those in February to 600 tons; and in March thus far to 280 tons.

SOUTH HECLA EXTENSION (Alta)—Work of driving Quincy level of South Hecla to this property being pushed with good progress.

VIRGINIA

Norfolk County

VIRGINIA SMELTING (West Norfolk)—Has installed leaching plant of Longmaid-Henderson system, with a Ramen Bescow chloridizing furnace for roasting. Both furnace and system of leaching are new in this country. This furnace is of Swedish design and is capable of roasting 60 to 70 tons per day, using producer gas.

WASHINGTON

Ferry County

SAN POIL (Republic)—Taken over under five-year lease and bond by newly organized West Hill Mining Co., price $150,000, terms $30,000 annually and 10% smelter returns to be applied on purchase price. Contract closed with Trail, B. C., smeltery for 2,000 tons monthly. Extensive development said to have blocked out large tonnage above 300 level, running $7 to $15 per ton gold. J. W. Turner, of Spokane, is president, and D. M. Drumheller, Jr., manager.

CANADA

British Columbia

SILVER HOARD (Ainsworth)—Reported planning installation of 200-ton daily capacity concentrator. George Chew, of Spokane, is president.

EMMA (Eholt)—Leased by Consolidated Mining and Smelting Co., electrically driven pump installed for draining; 12 drill compressor now being installed.

SLOCAN STAR (Sandon)—Plans construction of 3-mi. flume, 5,000-ft. aërial tram and enlargement of mill to 250-ton daily capacity. President Lennie has closed 3-year contract for entire output of mine with American Smelting and Refining Co.

Ontario

NORTH THOMPSON (Porcupine)—Will sink to 500-ft. level.

McKINLEY-DARRAGH (Cobalt)—Installing flotation plant of 175 tons a day capacity.

WEST DOME (Porcupine)—Is being unwatered. Treasury financed and development work will be resumed.

BUFFALO (Cobalt)—Installing flotation plant of 600 tons a day capacity to treat tailings from concentrator.

HOLLINGER (Porcupine)—Drifting on 1,275-ft. level, deepest working in district. Showings better than on 1,000-ft. level.

SCHUMACHER (Porcupine)—Mill capacity raised to 125 tons a day. Vein system intercepted on 600-ft. level with diamond drill.

RIGHT OF WAY (Cobalt)—Annual report for 1915 shows gross receipts $56,853, operating expenses, $44,582, leaving net profit of $12,252. Balance on hand was $13,188.

Quebec

NORTH AMERICAN MAGNESITE (Quebec)—Is successor of Magnesia Products, Ltd., that underwent reorganization some time ago; has declared dividend of 15%. War prices and scarcity of supplies has resulted in a strong demand for product.

The Market Report

Metal Markets

NEW YORK—Mar. 22

Lead continued to be the feature of outstanding interest, and there was considered to be a good deal of mystery in the situation, even in well-informed quarters. Spelter turned dull after the advance at the end of last week. Copper also was dull, but was very strong and steady.

Copper, Tin, Lead and Zinc

Copper—Following the little revival of interest toward the end of our last week of record, which brought about a rally in the price, although it fell short of what was being asked by the principal producers, the latter decided to meet the market, and on Mar. 16 reduced their asking price to 27c. r.t., for any delivery, including near-by to such extent as it could be supplied. Other producers offered at 27c. for near-by to May and down to 26½c., r.t., for May and June. At these prices a moderate business was done. There was a very good demand for near-by copper, but only slight interest in futures was exhibited. However, there was considerable placing of war orders for which copper is going to be needed; inasmuch as the copper requirements remain to be covered, buying for that purpose is anticipated shortly.

The stocks of copper at refineries are very low indeed, in some cases down to the irreducible minimum. Deliveries have lately been made on a very large scale. All possible advantage was taken of the lifting of the embargo by the New York, New Haven & Hartford R.R. for four days, and during that time some previous best-on-records in shipments of copper were exceeded. Apart from that amelioration of the situation, copper is now being shipped right along from the refineries to Sound ports—especially Bridgeport and New Haven—by steamers and barges. From those ports it is carried into the Naugatuck Valley by trolley lines, use being made of them at night. As is well known, about all of the copper that is sold in the Naugatuck Valley is booked at prices delivered there, i.e., the sellers pay the freight. The present method of shipment costs more than in the ordinary way, but that matter has been adjusted amicably by the buyers and sellers, both of whom are interested in keeping the business going.

Scarcely any business for export was reported during the last week. Offers of copper at less than the official quotation of £136 failed to develop anything. The sharp rise in Standard copper on Mar. 22 attracted attention here. No explanation of it was offered, and anyway the quotations for Standard copper in the London market are now of scarcely any influence in this market.

The Rio Tinto Co. has declared a dividend of 35s. per share on its ordinary shares of £5 par value.

Copper Sheets are 34c. per lb. for hot rolled and 35c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is 29@29½c. per lb. at mill, for carload lots.

Tin—Business in this metal was fairly active, but at a steadily decreasing price, the decline being due to the increased supply offered by arrivals. Certain ships, especially the "Kathlamba," with 1,025 tons from the Straits, arrived earlier than was expected.

Tin production of the Federated Malay States in February was 3,290 long tons. For the two months ended Feb. 29 the total was 8,175 tons in 1915, and 7,606 tons in 1916; a decrease of 569 tons.

Lead—The position of the A. S. & R. Co., which has produced a good deal of mystery in this market, is explained in an official communication published elsewhere in this issue. In that connection, the only new feature was the refusal of that company to quote definitely on its surplus over contractual obligations, acceptance of further orders being limited to settling of prices at the average of the month of delivery; in other words, all business is put practically upon the same terms as what had previously been arranged by contract. Among other producers there was a divergence of policy, some being disposed to stand out for the highest prices going, while others exhibited a disposition to protect domestic consumers as much as possible. Even in the St. Louis market, which at present is the most open market, producers gave to important domestic consumers rather large tonnages at half a cent a pound less than could easily have been realized at the same time on export and speculative business. There is undoubtedly a scarcity of prompt lead, and there has been talk about 9c. being offered, St. Louis, but the only offer of that sort whereof we have reliable information was one that comprised terms with which no one could comply. All of the business on St. Louis basis that was reported to us on Mar. 22 was done at about 8c., and at that level the market was strong and still active. Lead for May-June delivery is, however, freely offered at 7⅝c., St. Louis.

DAILY PRICES OF METALS IN NEW YORK

Mar.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
16	4.7631	56⅞	26¼ @26½	52½	7.00 @7.75	7.50 @8.00	15¾ @17
17	4.7638	57	26¼ @26½	51½	7.00 @8.00	7.50 @8.00	16 @17¼
18	4.7638	57	26¼ @26½	51	7.00 @8.00	7.50 @8.00	16 @17¼
20	4.7625	57⅛	26¼ @26½	50½	7.00 @8.00	7.50 @8.00	16 @17¼
21	4.7675	57⅛	26¼ @26½	49¾	7.00 @8.00	7.50 @8.00	16 @17¼
22	4.7625	58½	26¼ @26¼	49¾	7.00 @8.00	7.75 @8.25	15¾ @17½

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Mar.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
16	27⅛	106	103½	136	28.96	195	190	35	7.45	92	19.59
17	27 3/16	107½	104	136	28.96	195½	191	35½	7.56	93	19.80
18	27 3/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	27⅜	109	104½	136	28.95	196½	191½	36¾	7.74	92	19.59
21	27½	112½	109½	136	28.96	196	191	36	7.66	92	19.60
22	27⅜	118½	116	136	28.95	196½	191	36	7.67	92	19.59

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £ 15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

Spelter—The little spurt in activity which put up prices rather sharply toward the close of our last week of record, turned out not to amount to much, and after a day or two, the market became dull and uninteresting. The total of transactions during the week, so far as reported to us, was rather small. An interesting feature was the tendency for the difference between prices for prompt and future deliveries—up to June—to contract. The situation is evidently becoming easier with regard to near-by supplies. In some cases producers are simply beginning to catch up; in other cases they are probably beginning to accumulate a little, but as yet only a little. At the same time there is exhibited a disinclination in some quarters to sell beyond three months ahead, for the reason that the risks involved in such transactions are too great. Other producers, however, are not indisposed to take chances and sell freely for such deliveries as May to September, of course, at a sharp discount from prices that prevail for the coming quarter. Some business of that sort was done for export during the last week, but the aggregate was not large. There was, however, a bid for a round tonnage in the market at a price that was not favorably considered. At the close the market was flat, with prompt spelter quoted at 17@17⅛c., April at 16¾@17c., May at 16¼@16½c., and June at about 15¾@16 cents.

Exports from Baltimore for the week included 224,028 lb. spelter to Glasgow, Scotland.

Imports at Baltimore for the week included 3,000 tons zinc ore from Cagliari, Sardinia, and 2,000 tons zinc concentrates from Port Pirie, Australia.

New Smelting Works—In addition to those previously reported, the Picher interests of Joplin are to build at Henryetta, Okla., and H. M. Byllesby, of Chicago, is to build at Poteau, Okla. The Bartlesville Zinc Co. is already building at Blackwell, Okla. It is also reported that a Cleveland company is to build at Checotah, Okla. Besides these several other plants are seriously contemplated.

The spelter production of the Netherlands in 1915 is said to have been 12,243 short tons, compared with 18,098 in 1914, authority not stated.

Zinc Sheets—Business is steady and sales good. Prices are unchanged, the base price being $25 per 100 lb., f.o.b. Peru, Ill., with 8% discount.

Other Metals

NEW YORK—Mar. 22

Aluminum—This metal has advanced a little under stress of a fair demand. Sales have been made at 59@61c. per lb. for No. 1 ingots, New York.

Antimony—Business has been quite active, and for spot material the market seems unchanged. For futures the tendency is to easier prices. Chinese and other ordinary brands are still held at 44@45c. for spot delivery. For April, however, 42@43c. is named. Cookson's is very scarce and is held nominally at 57@60c. per lb., with very small sales.

Quicksilver—A further sharp decline in this metal is noted. Business is very quiet and sales have been small. The New York price is quoted at $200 per flask, but it is reported that sales have been made lower, at least one transaction at $175 per flask being noted. San Francisco reports by telegraph $200 per flask on a quiet market.

Nickel—Demand continues steady with good sales for domestic consumption and a larger demand for export. Quotations are unchanged at 45@50c. per lb., New York, according to size and terms of order. Electrolytic nickel is 5c. per lb. higher.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.25 per lb., New York. The London price is 11s. per lb.—**Cadmium** is quoted at $1.50 per lb., New York—**Cobalt** is held at $1.25 per lb. New York.—**Magnesium** is quoted at $6 per lb., nominally.—**Selenium** is from $3 per lb. for small lots up to $4.50@5 for retail quantities. Exports from Baltimore for the week included 660 lb. selenium to London.

Gold, Silver and Platinum

NEW YORK—Mar. 22

Gold—Some more gold is reported going from New York to Argentina. Some gold has also gone to Cuba in connection with the new coinage for that county.

Gold in the United States Mar. 1 is estimated by the Treasury Department as follows: Held in Treasury against gold certificates outstanding, $1,494,563,659; in Treasury current balances, $204,075,899; in banks and circulation, $620,333,769; total, $2,318,973,327, a decrease of $9,448,508 in February.

Under the present law two-thirds of the gold held by the Treasury against gold certificates outstanding must be in U. S. coin; the balance can be in bullion or foreign coin. In view of the present great accumulation of gold the Treasury Department has asked Congress to reduce the proportion of U. S. coin required from two-thirds to one-half. The object is to avoid the expense of recoining the large amount of foreign gold coin coming in.

Platinum—There is no change in the market. Supplies are short and prices hold at a high level. Sales are reported made at $85@95 per oz. for refined platinum. Hard metal is quoted at $90 up to $100 per oz. for 10% alloy.

Our Russian correspondent writes that the government has rejected the proposed bill which provided that all metal must be delivered to government officers as produced. The platinum which has already been taken over will be bought by the government at a fixed price, but the future production and the market will be free. The market is in a confused position at present, until the effect of this action becomes clear.

Silver—The market has advanced owing to London orders with limited supplies. Considerable silver is required for mintage purposes and these demands combined with miscellaneous outside inquiries have stiffened the price to 27⅞d. in London, which is bid today.

The Commonwealth of Australia has undertaken to mint about £500,000 in silver coins, to meet the large demand for such coins which has arisen. The dies will be supplied by the English Mint.

By reason of an error in transmission the price of silver in London on Jan. 27 last was given at 26¾d.; it should have been 26⅞d. This will change slightly the average price in London for the month of January from 26.953d., to 26.960d., the correct figure.

Zinc and Lead Ore Markets

JOPLIN, MO.—Mar. 18

Blende, high price, $116.90; per ton 60% zinc, premium ore, $115; medium, $110@100; lowest, $95; calamine, per ton 40% zinc, $86@80; average selling price, all grades zinc, $105.98 per ton. Lead, high price, $98.80; per ton 80% metal contents $94@98; average selling price, all grades lead, $94.99 per ton.

SHIPMENTS WEEK ENDED MAR. 18

	Blende	Calamine	Lead	Values
Totals this week..	9,209,850	1,041,690	3,335,680	$701,620
Totals this year...	143,529,360	12,147,690	24,796,810	9,409,850

Blende value the week, $499,550; 11 weeks, $7,920,340.

Calamine value, the week, $43,630; 11 weeks, $447,870.

Lead value, the week, $158,440; 11 weeks, $1,041,640.

At a meeting of producers this week, from what has become public, no further move was made toward the organization of a selling agency, but it was resolved that they could not afford to sell at current prices and the consensus of opinion was that it would be necessary to restrict the output until metal advanced to a point that would warrant resuming operations. It came out in this meeting that a reduction in wages in proportion to the reduction in ore prices would undoubtedly precipitate a general strike, as organizers have been quite active here throughout the winter. Smelting interests, unprepared for a restricted output, decided to advance prices.

PLATTEVILLE, WIS.—Mar. 18

The base price paid this week for 60% zinc ore was $100@101 per ton. The base price paid for 80% lead ore was $90 per ton.

SHIPMENTS, WEEK ENDED MAR. 18

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,138,000	318,400	1,833,960
Year	45,972,000	1,018,100	11,580,200

Shipped during week to separating plants, 5,430,000 lb. zinc ore.

MONTANA ZINC ORES

The Butte & Superior Co. reports for February 54,380 tons ore milled, with a recovery of 14,886 tons concentrates assaying 52.6% zinc. Estimated zinc contents were 15,645,000 lb. in February.

Iron Trade Review

NEW YORK—Mar. 22

The steel market might now be fairly characterized as a runaway market. Price advances continue to be made, but they do not seem to have any effect on orders.

Railroad equipment and shipbuilding orders are prominent and will absorb a heavy tonnage of steel. Structural orders are also on the increase and some large tonnages are under negotiation. The mills are running up to capacity, but railroad congestion is interfering to a serious extent with deliveries of material.

The pig-iron market is strong and prices are firm. This market is not so wild, however, as that for finished steel. Large tonnages of foundry and basic are reported sold, and furnace capacity for the second half is being rapidly taken up.

Exports from Baltimore for the week included 4,482,690 lb. bars and billets to Marseilles; 857,900 lb. billets to Rotterdam.

Imports of iron and steel in January, so far as reported by tonnage, were 15,824 tons, an increase of 5,255 tons over last year. Considerable increases in imports in recent months have been due to the steel rails shipped by the Algoma Steel Co. from Sault Ste. Marie.

PITTSBURGH—Mar. 21

Slight signs are commencing to appear of "the beginning of the end" in this unprecedented steel movement, yet the current developments are all in the direction of steel prices advancing and steel becoming scarcer. The particular development definitely reflecting the collapse that must come eventually is that some buyers show a decided disinclination to contract for far forward delivery, at the high prices now asked. Until very lately practically all buyers were willing to contract for longer periods than the mills would consider. Another suggestion that there will ultimately be another side to this steel movement is the seriousness with which even the wildest and vaguest rumors of impending peace in Europe are taken. This suggests that when the real news comes some time that peace actually is to be declared the panic of fear will outclass that which occurred in October and November, 1914, when everything looked so dark in the American steel trade.

All the trends of the moment, however, are upward. Steel boiler plate for prompt shipment is rumored to have brought 5c. or more, while tank plate has brought 4c. if not more. Prompt steel bars seem cheap at 3c., formerly considered a very high price for large rounds made to war steel specifications. The realization of such high prices prompts the large mills to advance prices for late deliveries, but the turnover at premium prices for prompt shipment is small in point of tonnage and the prices are paid very unwillingly, the buyers frequently losing money. Many manufacturing consumers will have to curtail operations, and the chief question is when enough will be forced to do so to affect measurably the total demand for steel. While fancy prices are paid on small tonnages, large tonnages are still being shipped at prices ruling six months ago, far below those of the present and consumers taking such steel may take much less when it comes to paying the high prices.

The Carnegie Steel Co. has made additional purchases of heavy melting steel scrap and steel turnings, making its total purchases in the past few weeks fully 150,000 tons. It is thought the Steel Corporation will soon be forced to buy pig iron as well, since it is now "nip and tuck" between the Corporation's blast furnaces and its steel mills, while the steel-making capacity is being increased, with two 25-ton converters being added both at Donora and at South Chicago, to convert the plants into duplexing plants, a complete duplexing plant with openhearth furnaces being added at Gary, and 10 openhearth furnaces being added at plants in this district and Ohio.

Pig Iron—In a general way it is remarked that pig iron is the only commodity in the iron and steel industry that has not doubled in price, so that pig iron may have its inning, perhaps by the Steel Corporation buying, as indicated possible in the foregoing. The market is strong though not particularly active. A few lots of bessemer, aggregating about 2,000 tons, have sold in the past few days at $21, Valley, and there is export demand at even higher prices. Purchases of basic iron in the past two or three weeks by steel works in this general district make up a fair tonnage, and there is little left to offer. Foundry iron is moving fairly well and would move much better were it not for the molders' strike, now more than three months old. We quote: Bessemer, $20.50@21; basic, foundry and malleable, $18.50@19; forge, $18@1850, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—There remain very few mills willing to sell any sort of billets or sheet bars, and the market is largely nominal at $40@45, prices that would probably be paid by many consumers. Forging billets are $60@70, sometimes bringing more if the specification is at all close or the delivery prompt. Rods at $55 have become practically nominal, while high-carbon rods bring $75@85 per ton.

FERROALLOYS

Ferromanganese—The $175 quotation on contracts for English ferromanganese has not disappeared, but hardly any deliveries are obtainable before the early months of next year. Prompt lots when obtainable at all bring fabulous prices; in the neighborhood of $400. Domestic ferromanganese running 50 to 60% manganese is held at $5.20 a unit, while spiegel is $55@60.

Receipts at Baltimore for the week included 1,450 tons ferromanganese from England.

Spiegeleisen—For high-grade alloy, 35% manganese, as high as $125 per ton has been quoted; while $60 per ton, Pittsburgh, has been paid for 20% manganese.

Ferrosilicon—The supply is not equal to the demand and prices are advancing on high-grade material. For 50% alloy $83@85 per ton, Pittsburgh, is the nominal quotation, but premiums are reported paid for early delivery. Bessemer ferrosilicon is quoted from $30 for 9% up to $41 for 16%, at furnace.

Canada's output of ferrosilicon from electric furnaces in 1915 was 9,603 gross tons, valued at $753,406, compared with 6,717 tons in 1914, an increase of about 43%. The Electro Metals, Ltd., Welland, Ont., has considerably enlarged its capacity to turn out this alloy. About two-thirds of the Canadian output in 1915 was 50% ferrosilicon.

IRON ORE

The rail shipments of iron ore from the Lake Superior region in 1915 are reported at 953,947 tons; making the total shipments for the season 47,272,751 tons.

OTHER ORES

Antimony Ore is in fair demand and is selling at about $2.75 per unit, New York.

Manganese Ore has been sold at 70@80c. per unit for Brazilian ore at tidewater. The supply is not large, most of that arriving being under contract.

Tungsten Ore is in demand and strong. Sales are reported around $85 per unit for 60 to 65% WO_3. For forward delivery $70@75 per unit is quoted.

The Vasco Mining Co., of Boulder, Colo., is in the market for tungsten ore of all grades.

The Colorado Tungsten Mines Co. at Boulder, Colo., has announced that it will pay $90 per unit for ore carrying 60% WO_3, with corresponding advances for lower grades. This advance is the result of competition with the Boulder Tungsten Production Co. which offered an increase last week.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier" at 457,894 short tons; shipments, 463,244 tons. Shipments from the Greensburg and Upper Connellsville districts were 41,318 tons.

Connellsville—It develops that a contract was made last month for 13,000 tons of furnace coke a month over the second half of the year at $2.50. Two contracts have been reported since then at $3 for shipment to the end of the year. This week spot furnace coke has slumped 50c., there being many offerings of small lots at $3.25, and it is likely the day of particularly high prices is over, especially as the new byproduct ovens will begin coming in next month, starting with the South Bethlehem addition and being followed by Toledo, Youngstown, Cleveland and Dover. We quote: Spot furnace, $3.25; contract, $2.50@3; spot foundry, $3.75@4; contract, $3.25@3.75, per net ton at ovens.

Chemicals

NEW YORK—Mar. 22

The general markets still show a strong undertone and business is fairly active for the season.

Arsenic—The market is firm and demand good. Glass makers have been taking some material, owing to the very high price of antimony oxide. The quotations are $6@6.50 per 100 lb., according to size of order.

Copper Sulphate—The export demand is increasing and inquiries are coming in from various countries. Quotations are $21 per 100 lb. for large orders; $21.25@21.50 for smaller quantities

Nitrate of Soda—The price is held up by a good demand and high ocean freights. It is reported that some resale lots are on the market from parties who bought under contract some time ago. The current quotations hold at about $3.60 per 100 lb. for spot material.

PETROLEUM

A tract of 494 acres of asphalt and petroleum land near the City of Puerto Cabello has been leased by the Government of Venezuela for 25 years to Guillermo Pimentel Troconis The contract, which is published in the "Gaceta Oficial" of Feb. 16, stipulates that a royalty shall be paid on product exploited in addition to the amount paid for the use of the land. The contractor may import needed machinery free of duty, but at the end of 25 years such machinery will become the property of the Government. During the period of exploitation the Government may purchase from the contractor such quantities of asphalt and petroleum products as it may require at a discount of 20% from market prices.

Assessments

Company	Delinq.	Sale	Amt.
Adventure, Mich.	July 20	.....	$0.50
Basalt, Nev.	Mar. 8	Apr. 6	0.003
Beaver, Utah	Mar. 18	Apr. 8	0.01
Caledonia Silver, Nev.	Apr. 7	Apr. 28	0.05
Con. Virginia, Nev.	Mar. 14	Apr. 4	0.05
East Caledonia, Ida.	Mar. 21	Apr. 10	0.01
Emerald, Utah	Mar. 15	Apr. 11	0.00½
Federal Ely, Nev.	Mar. 1	Apr. 3	0.005
Federal Ely, Nev.	Apr. 1	May 1	0.005
Federal Ely. Nev.	May 1	June 4	0.005
Flagstaff, Ida.	Mar. 20	Apr. 15	0.002
Great Bend, Nev.	Apr. 5	May 8	0.01
International, Ida.	Mar. 16	Apr. 10	0.002
Mayflower, Ida.	Mar. 15	Apr. 15	0.005
Mountain Rose, Ida.	Mar. 8	Apr. 8	0.001
National Copper, Ida.	Mar. 25	Apr. 22	0.01
Native Silver, Mont.	Feb. 21	Apr. 4	0.0025
Nevada Stewart, Ida.	Mar. 25	Apr. 14	0.002
New Quincy, Utah	Mar. 11	Mar. 30	0.01
Old Veteran, Ida.	Mar. 9	Apr. 1	0.002
Ophir, Nev.	Mar. 22	Apr. 12	0.05
Paloma, Utah	Mar. 18	Apr. 8	0.01
Park Gold, Utah	Apr. 1	Apr. 20	0.001
Rhode Island, Ida.	Mar. 30	May 15	0.002
Rio Grand Grubstake, Nev.	Mar. 27	Apr. 22	0.006
Rockford, Ida.	Mar. 15	Apr. 15	0.001
Silver Mt., Ida.	Feb. 17	Apr. 15	0.002
Silver Pick Con., Nev.	Feb. 28	Apr. 3	0.01
Sixes Min., Nev.	Mar. 17	Apr. 1	0.10
Summit Ex., Utah	Mar. 15	May 1	0.01
Sunset, Nev.	Mar. 27	Apr. 29	0.01
Tintic Milling, Utah	Mar. 14	Apr. 3	0.03
Tintic Standard, Utah	Mar. 15	Apr. 10	0.005
Tonopah Bonanza, Nev.	Apr. 3	May 8	0.01
Tono. Gypsy Qn., Nev.	Mar. 20	Apr. 24	0.01
Utah Metals, Utah	Mar. 11	Apr. 15	0.001
Utah-United, Utah	Mar. 10	Mar. 30	0.01
Uvada, Nev.	Feb. 21	Mar. 30	0.02

Auction sales in the week ended Mar. 18, 1916: In New York, $11,000 Paint Creek Collieries 5s ctf. of dep., $2,120, Lackawanna Coal and Lumber 6s, $300 lot; in Boston, $5,000 Alvarado Min. and Mill con. 6s, 73½; in Philadelphia, 1,200 Humboldt Oil, $5 par, $2 lot; 500 Germania Oil, $5 par, $2 lot; 200 National Oil, Tampico, $1 par, 1¼ each.

Stock Quotations

COLO. SPRINGS	Mar. 21	SALT LAKE	Mar. 21
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.04½	Beck Tunnel	.27
Cripple Cr'k Con.	‡.007	Black Jack	.13½
Dante	.02	Colorado Mining	.25
Doctor Jack Pot	.10½	Crown Point	.07½
Elkton Con.	.30½	Daly-Judge	8.00
El Paso	.76	Emma Cop.	.48
Findlay	.05½	Gold Chain	.23½
Gold Dollar	.02½	Grand Central	.76
Gold Sovereign	.04½	Iron Blossom	1.80
Golden Cycle	2.08	Lower Mammoth	.07
Isabella	.21½	May Day	.15½
Jack Pot	.06½	Opohongo	.03
Jerry Johnson	.05½	Prince Con.	1.35
Lexington	‡.005	Seven Troughs	.01½
Mary McKinney	.44	Silver King Coal'n.	3.30
Pharmacist	‡.009	Silver King Con.	2.90
Portland	1.81	Sioux Con.	.12½
Raven B. H.	‡.01	Uncle Sam	.08½
Vindicator	2.33	Yankee	.31

SAN FRANCISCO	Mar. 21		
Alta	.05	Belmont	4.30
Andes	.06	Jim Butler	.84
Best & Belcher	.03	Lone Star	.02
Bullion	.01	MacNamara	.06
Caledonia	.30	Midway	.19
Challenge Con.	.05	Mont.-Tonopah	.25
Confidence	.13	North Star	.15
Con. Virginia	.11	Rescue Eula	.25
Gould & Curry	‡.02	West End Con.	.74
Hale & Norcross	.02	Atlanta	.13
Jacket-Cr. Pt.	.10	Blue Bell	.02
Julia	‡.01	Booth	.32
Mexican	.15	C.O.D. Con.	.03
Occidental	.75	Comb. Frac.	.07
Ophir	.19	D'field Daisy	.03
Overman	.04	Jumbo Extension	.76
Savage	.06	Pitts.-Silver Peak	.07
Seg Belcher	.02	Round Mountain	.62
Sierra Nevada	.23	Sandstorm Kendall	.05
Union Con.	.40	Silver Pick	.06
Utah Con.	.02	Central Eureka	.09

TORONTO	Mar. 21		
Bailey	.05½	Dome Exten.	.38½
Chambers Ferland	.22	Dome Lake	.29
Coniagas	3.90	Foley O'Brien	.50
La Rose	.61	Hollinger	26.00
Peterson Lake	.24½	Imperial	.02½
Right of Way	.05	Jupiter	.20½
Seneca Superior	.57	McIntyre	‡.91
T. & Hudson Bay	26.00	Porcu. Crown	‡.73
Temiskaming	.51	Preston E. D.	‡.04½
Trethewey	.12	Vipond	.65
Wettlaufer-Lor.	.07	West Dome	.15

LONDON	Mar. 8		
Alaska Tre'dwell	£6 10s 0d	Mexico Mines	£3 15s 0d
Burma Corp.	1 16 0	Nechi, pfd.	0 14 3
Cam & Motor	0 11 6	Oroville	0 13 6
Camp Bird	0 7 0	Santa Gert'dis.	0 10 6
El Oro	0 8 0	Tomboy	1 1 6
Esperanza	0 10 0	Tough Oakes	0 12 6

N. Y. EXCH.	Mar. 21	BOSTON EXCH	Mar. 21
Name of Comp.	Clg.	Name of Comp.	Bid
Alaska Gold M.	19½	Adventure	2¼
Alaska Juneau	9¾	Ahmeek	398
Am.Sm.&Ref.,com	101½	Algomah	1½
Am. Sm. & Ref., pf.	112½	Allouez	68½
Am. Sm. Sec., pf. A	92¾	Ariz. Com., ctfs.	8¼
Am. Sm. Sec., pf. B	86	Bonanza	‡.35
Am. Zinc	85½	Butte Alex. Scott	‡10½
Anaconda	86½	Butte-Balaklava	4
Batopilas Min.	2½	Calumet & Ariz.	72
Bethlehem Steel	505	Calumet & Hecla	550
Bethlehem Steel, pf.	132	Centennial	17¼
Butte & Superior	88¾	Copper Range	63
Chile Cop.	22½	Daly West	3½
Chino	54	East Butte	12½
Colo. Fuel & Iron	45½	Franklin	8½
Crucible Steel	90	Granby	89½
Dome Mines	24½	Hancock	15
Federal M. & S.	26½	Hedley	‡22
Federal M. & S., pf.	51	Helvetia	.40
Great Nor., ore., ctf.	44½	Indiana	3½
Greene Cananea	47⅞	Island Cr'k, com.	45½
Guggen. Exp.	21	Island Cr'k, pfd.	90
Homestake	132	Isle Royale	27
Inspiration Con.	47⅞	Keweenaw	3½
International Nickel	46¼	Lake	17¼
Kennecott	56½	La Salle	4½
Lackawanna Steel	79½	Mason Valley	2½
Miami Copper	36¾	Mass.	13¾
Nat'l Lead, com.	67½	Mayflower	3
National Lead, pf.	113	Michigan	2
Nev. Consol.	15½	Mohawk	96
Ontario Min.	7½	New Arcadian	8
Quicksilver	4	New Idria	15
Quicksilver, pf.	5	North Butte	28
Ray Con.	23⅜	North Lake	1½
Republic I&S, com.	51½	Ojibway	1½
Republic I&S, pf.	109½	Old Colony	2⅜
Sloss-Sheffield	57	Old Dominion	66¼
Sloss-Sheffield, pf.	90	Osceola	96
Tennessee Copper	54	Quincy	92½
Utah Copper	81½	St. Mary's M. L.	70
U. S. Steel, com.	84⅜	Santa Fe	2½
U. S. Steel, pf.	116½	Shannon	9½
Va. Iron C. & C.	52	Shattuck-Ariz.	37
		So. Lake	7
N. Y. CURB	Mar. 21	So. Utah	.30
Alta Con.	‡.24	Superior	16½
Beaver Con.	.38	Superior & Bost.	3½
Big Four	‡.04	Tamarack	53
Buffalo Mines	1⅛	Trinity	8½
Butte & N. Y.	3	Tuolumne	.30
Butte C. & Z.	9	U. S. Smelting	67½
Can. Cop. Corpn.	1½	U. S. Smelt'g, pf.	50½
Cashboy	.06	Utah Apex	4⅛
Cerro de Pasco	37½	Utah Con	14
Con. Ariz. Sm.	1⅞	Utah Metal	10½
Con. Coppermines	1⅛	Victoria	3½
Con. Nev.-Utah	.50	Winona	4
Dia. Black B.	.01	Wolverine	59
First Nat. Cop.	6½	Wyandot	2
Florence	.39		
Goldfield Con.	.88	BOSTON CURB	Mar. 21
Goldfield Merger	.11½	Bingham Mines	12½
Hecla Min.	4¾	Boston Ely	.45
Howe Sound	5½	Butte & Lon'n Dev.	.71
Kerr Lake	3⅛	Calaveras	3
Magma	17⅛	Calumet-Corbin	.06
Majestic	⅛	Chief Con.	1⅛
McKinley-Dar-Sa.	.41	Cortez	.60
Mines of Am.	2⅜	Crown Reserve	.38
Mother Lode	.25½	Davis-Daly	1½
Nevada Hills	.20	Eagle & Blue Bell	2⅛
New Utah Bingham	4	Houghton Copper	2
Nipissing Mines	6¾	Iron Cap Cop., pf.	6
Oro	.04	Mexican Metals	.46
Ray Hercules	3½	Mojave Tungsten	5
Rochester Mines	.60	Nat. Zinc & Lead	3½
St. Joseph Lead	16½	Nevada-Douglas	.91
Stand'd Oil of N.J.	524	New Baltic	3
Standard S. L.	1⅛	New Cornelia	15½
Stewart	⅛	Ohio Copper	.18
Success	.78	Oneco	1
Tonopah	6	Raven Copper	.18
Tonopah Ex.	4¼	Rex Cons.	.17
Tonopah Merger	.55	Rilla	1
Tribullion	⅛	United Verde Ext.	19½
White Knob, pf.	1¾		
Yukon Gold	2¼	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	.....	26.788	23.708	.....
April	58.519	50.250	.....	26.958	23.709	.....
May	58.175	49.915	.....	26.704	23.570	.....
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.604	.....	27.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.17
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	.....	66.152	.....	*	.....
April	16.811	.....	75.096	.....	*	.....
May	18.506	.....	77.600	.....	*	.....
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
Aug.	16.941	.....	68.673	.....	82.333	.....
Sept.	17.502	.....	68.915	.....	85.250	.....
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	.....	180.141	.....
April	47.884	.....	166.225	.....
May	38.790	.....	162.675	.....
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.500	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	.....	3.997	.....	21.883	.....
April	4.221	.....	4.142	.....	21.094	.....
May	4.274	.....	4.182	.....	20.347	.....
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.628	.....	4.587	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	.....	8.360	.....	44.141	.....
April	10.012	.....	9.837	.....	49.888	.....
May	14.781	.....	14.610	.....	68.100	.....
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug.	12.781	.....	12.611	.....	67.786	.....
Sept.	13.440	.....	13.270	.....	67.841	.....
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	.....	13.45	.....	13.95	.....
April	14.55	.....	13.45	.....	13.95	.....
May	14.64	.....	13.60	.....	13.83	.....
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	18.26	.....	17.30	.....	17.20	.....
December	19.95	.....	18.95	.....	18.95	.....
Year	$14.89	.....	$13.76	.....	$13.89	.....